UNIT 4

How is wellbeing developed and maintained?

AREA OF STUDY 1

How do levels of consciousness affect mental processes and behaviour?

AREA OF STUDY 2

What influences mental wellbeing?

OUTCOME 1

- explain consciousness as a continuum, compare theories about the purpose and nature of sleep, and elaborate on the effects of sleep disruption on a person's functioning

OUTCOME 2

- explain the concepts of mental health and mental illness including influences of risk and protective factors, apply a biopsychosocial approach to explain the development and management of specific phobia, and explain the psychological basis of strategies that contribute to mental wellbeing

AREA OF STUDY 3

Practical investigation

CHAPTER

8 Nature of consciousness

KEY KNOWLEDGE

- consciousness as a psychological construct that varies along a continuum, broadly categorised into normal waking consciousness and altered states of consciousness (naturally occurring and induced)
- the measurement of physiological responses to indicate different states of consciousness, including electroencephalograph (EEG), electromyograph (EMG), electro-oculograph (EOG) and other techniques to investigate consciousness (measurement of speed and accuracy on cognitive tasks, subjective reporting of consciousness, including sleep diaries, and video monitoring)
- changes in a person's psychological state due to levels of awareness, controlled and automatic processes, content limitations, perceptual and cognitive distortions, emotional awareness, self-control and time orientation
- changes in levels of alertness as indicated by brain waves patterns (beta, alpha, theta, delta) due to drug induced altered states of consciousness (stimulants and depressants)
- the effects on consciousness (cognition, concentration and mood) of one night of full sleep deprivation as a comparison with effects of legal blood-alcohol concentrations.

Stop for a moment and focus your attention on your thoughts and feelings right now. Are you thinking about the words in this paragraph, something a friend said to you, how hungry you are, what someone else in the room is saying, or something completely different? Now focus your attention on how you feel. Perhaps you feel tired, bored, happy or even curious. Next, switch your attention to the sounds around you. Try to identify the different sounds you can hear. Now change the focus of your attention to what you can see, or the texture of your clothes against your skin. Try to become aware of the rhythm of your breathing, the aromas in your nose, and any aches, itches or pressure you may feel. Before your attention was directed to any of these things, were you actually aware of them or did they just exist without your awareness? The answer can be found in the study of consciousness.

Differences in levels of awareness of sensations, thoughts and surroundings influence our interactions with our environment and other people. In this chapter we examine the nature of consciousness and the relationship between consciousness and thoughts, feelings and behaviours. We also explore the different ways in which consciousness can be studied from physiological and psychological perspectives and how states of consciousness can be altered.

FIGURE 8.1 Sometimes your consciousness is dominated by internally focussed thoughts and feelings; at other times it is dominated by sensations and perceptions from the external environment.

CONSCIOUSNESS AS A PSYCHOLOGICAL CONSTRUCT

A challenge in studying consciousness is that it cannot be actually seen, unlike the study of physical characteristics such as eye colour or height, or behaviour such as walking and talking. Consciousness is therefore referred to as a psychological (or hypothetical) construct.

A **psychological construct** is a concept that is 'constructed' to describe specific 'psychological' activity, or a pattern of activity, that is believed to occur or exist but cannot be *directly* observed. In studying an individual's state of consciousness, researchers typically rely on:

- information provided by the individual (e.g. self-reports), and/or
- behaviour that is demonstrated (e.g. responses during experimental research), and/or
- physiological changes that can be measured (e.g. recording brain activity).

On the basis of such information, *inferences* are made about an individual's underlying state of consciousness. As techniques for studying consciousness have become more sophisticated, so too has the understanding of consciousness and how it is defined.

There have been many different definitions of consciousness throughout the history of psychology. Most refer to awareness of external and internal stimuli, but not just sensory stimuli because consciousness also involves *self*-awareness. More specifically, **consciousness** can be defined as our awareness of objects and events in the external world, and of our sensations, mental experiences and own existence at any given moment. Our consciousness helps provide us with a sense of self — a personal identity through which we experience the world.

Whatever we are aware of at any given moment is commonly referred to as the *contents* of consciousness. The contents of consciousness can include anything you think, feel and physically or mentally experience; for example:

- your awareness of your internal sensations, such as your breathing and the beating of your heart
- your awareness of your surroundings, such as your perceptions of where you are, who you are with and what you see, hear, feel or smell
- your awareness of your self as the unique person having these sensory and perceptual experiences
- the memories of personal experiences throughout your life
- the comments you make to yourself
- your beliefs and attitudes
- your plans for activities later in the day.

FIGURE 8.2 Consciousness is a psychological construct as it cannot be directly observed or measured.

Consciousness is an *experience* — a moment by moment experience that is essential to what it means to be human. The experience is commonly described as being personal, selective, continuous and changing. It is *personal* because it is your subjective ('personalised') understanding of both your unique internal world and the external environment — it is individual to you. Consciousness is *selective* because you can choose to attend to certain things and ignore others. You can voluntarily shift your attention from the words on this page to a voice in the room or the memory of what you did last Saturday night. Consciousness is *continuous* because there is never a time in the course of a typical day when your consciousness is 'empty'. Consciousness is constantly *changing*, with new information continually coming into awareness, particularly while you are awake. One moment your conscious awareness may be focused on the sound of a person talking to you, and the next moment your consciousness may be filled with thoughts of an argument you had with a friend. There are times when your consciousness is dominated by the internal thoughts and feelings you experience, while at other times sensations from the external environment dominate.

Over 125 years ago, the eminent American psychologist William James (1890) likened consciousness to a continuously flowing 'stream' because its contents are continuously moving and changing, just as the water in a stream continuously flows. The never-ending flow of thoughts, feelings, sensations and so on, are ever-changing, multi-layered and vary in the depth or 'levels' of awareness that we have of these experiences. The different levels of awareness that we experience at different times are commonly referred to as **states of consciousness** and the various states of consciousness have each been associated with distinguishable psychological and physical characteristics.

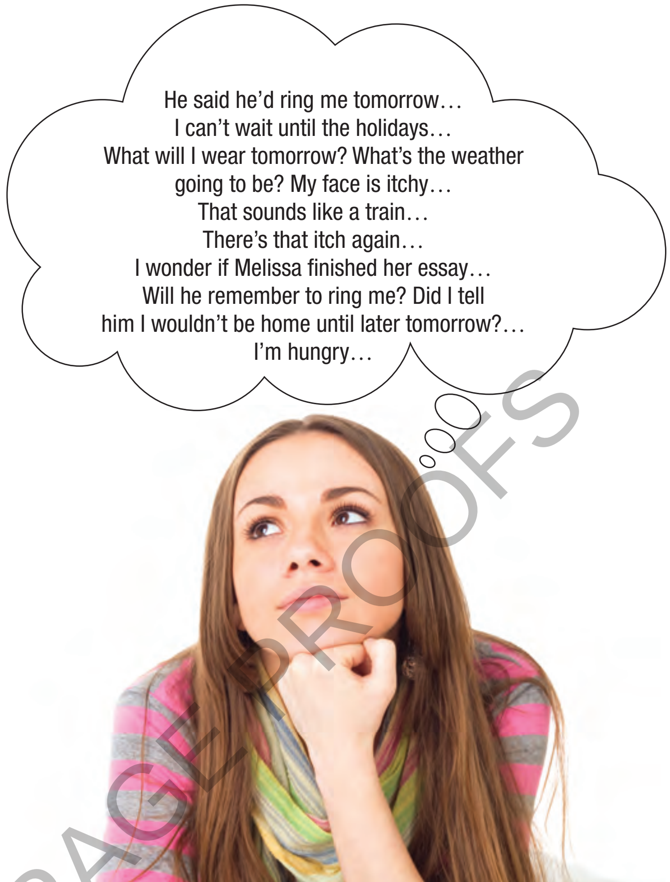

FIGURE 8.3 An example of what William James (1890) called the 'stream of consciousness' — a never-ending, ever-changing, flow of thoughts, feelings, sensations and so on which often occur in a random way

LEARNING ACTIVITY 8.1

Reflection

A snapshot of your consciousness

For the next five minutes, write down all the sensations, perceptions, memories, thoughts, images and feelings that flow into your consciousness. Write continuously for the whole time. If you can't think of anything to write, write 'I can't think of anything to write' (because that's what is in your consciousness) until the flow of other things continues. You may find that your hand can't keep up with the ever-changing flow of thoughts and feelings passing through your consciousness.

At the end of the time, count the number of different ideas that entered your consciousness. Compare your result with that of other class members. What is a possible explanation for any differences?

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TED talk on the nature of consciousness.

- Our shared condition — consciousness 15m 7s
- The quest to understand consciousness 18m 35s

CONSCIOUSNESS VARIES ALONG A CONTINUUM OF AWARENESS

Consciousness is not an 'all or nothing' phenomenon. As well as ongoing content changes, we experience variations in the extent or degree of overall awareness at different times. At times, we are highly focused and acutely aware; for example, when we are concentrating on learning how to use a new email function or lining up to shoot a goal. At other times, we experience a medium level of awareness, such as when we are daydreaming. There are still other times, such as when we are in deep, dreamless sleep, when our overall level of awareness is very low.

Psychologists often describe consciousness as varying along a **continuum of awareness** with two distinctive extremes — total awareness (e.g. focused attention) and complete lack of awareness (e.g. unconscious in a deep coma or a vegetative state). In between are other states involving more or less overall awareness.

In a typical day we experience many different states of consciousness and therefore many levels of awareness. Each level of awareness varies in distinctive qualities. As shown in the example of a continuum in figure 8.4, there are no clear-cut boundaries to indicate where one state of consciousness ends and another begins.

FIGURE 8.4 Psychologists often describe consciousness as ranging along a continuum of awareness from total awareness to a complete lack of awareness. There is, however, no 'precise' location for each level or state within the continuum.

At one end of the continuum, when attention is highly focused, concentration on specific thoughts, feelings or sensations dominates our consciousness to such an extent that other incoming information may not be noticed. For example, if you were totally absorbed in important school work during the first class of the day, you might not feel hungry despite having missed breakfast and not much for dinner the night before. At the other end of the continuum, an individual may not experience any thoughts, feelings or sensations at all. For example, someone in a deep coma or a vegetative state usually shows no evidence of awareness of themself or of their environment (see box 8.1).

There are many states of consciousness between either end of the continuum in which individuals have differing levels of overall awareness and specific qualities of awareness. These variations of consciousness may occur, for example, when people are in a fight, flight or freeze mode, fatigued, drowsy, daydreaming, asleep, in a meditative state or under the influence of alcohol, medication or an illegal drug. While it is sometimes difficult to distinguish between the different states of consciousness and associated levels of awareness within a continuum, psychologists generally agree on a broadly based distinction in terms of normal waking consciousness and altered states of consciousness.

BOX 8.1

Coma, vegetative and minimally conscious states

To be aware, we need to be awake but when awake, we are not necessarily aware. This is apparent when consciousness is impaired through brain injury, particularly to cortical areas and/or to brainstem structures regulating sleep and wakefulness. For example, some brain injuries may cause a coma or a vegetative state involving a decrease in, partial or complete loss of consciousness. In most cases of severe brain injury, the patient recovers within a few weeks, but in some cases, they may remain in a state of no awareness or minimal consciousness for several months, years or even decades.

Belgian psychologist Olivia Gosseries and her colleagues (2011) have described different conditions involving impaired consciousness that are attributable to brain injury. These include:

Coma

Coma is a state in which there is a complete or nearly complete loss of all basic functions of consciousness. Typically, the patient lies with eyes closed, cannot verbalise or respond to commands and cannot be awakened even when intensively stimulated. There is no evidence of awareness of self or of the environment. Comatose patients can, however, often present reflexive responses to painful stimulation. Autonomous nervous system functions such as breathing and regulation of body temperature are reduced and the patients require respiratory assistance. Prolonged comas are rare but can last 2–5 weeks and then progress to a vegetative state, locked-in syndrome or brain death.

Vegetative state

The vegetative state, sometimes called unresponsive wakefulness syndrome, involves loss of consciousness, but the patient may open their eyes, either spontaneously or after stimulation. As with coma, patients in a vegetative state cannot verbalise or make voluntary responses. Nor is there any sign of awareness of self or the environment. The patient in a vegetative state is awake but not aware, which suggests that wakefulness and awareness may be different components of consciousness.

Unlike coma, autonomic nervous system functions are preserved and breathing usually occurs without assistance. Someone in a vegetative state is also able to perform a variety of actions, such as grinding teeth, blinking and moving eyes, swallowing, chewing, yawning, crying, smiling, grunting or groaning, but these are always reflexive, unrelated to the context and often lacking in intensity.

FIGURE 8.5

Minimally conscious state

The minimally conscious state is characterised by inconsistent signs of awareness of self and the environment and there is evidence of voluntary, intentional behaviour, such as responding to verbal commands, making understandable verbalisations and tracking a moving object, mirror or person. Emotional behaviours, such as smiles, laughter or tears may also be observed. The minimally conscious state may be temporary, long-lasting or permanent, such as the vegetative state.

(continued)

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Locked-in syndrome

Locked-in syndrome, also called pseudocoma, is a rare condition involving full consciousness and complete paralysis of the body. Oral and gestural communications are impossible, but patients are often able to blink and move the eyes. Despite the fact that the patients cannot move, their sensations are still intact and they are fully aware of their environment and themselves. The most common way for patients with locked-in syndrome to communicate with their environment is through eye movements (such as blinking once for yes and twice for no), but they may recover control of their fingers, toes or head and use these as a means for communication too.

Brain death

In Australia, brain death is defined as (a) irreversible cessation of all function of the brain of the person; or (b) irreversible cessation of circulation of blood in the body of the person. Whole brain death is also required for the legal determination of death. Assessments occur when the patient transitions from a deep comatose state. If the condition causing coma and loss of all brainstem function has affected only the brainstem and there is still blood flow to the cerebral cortex, this does not meet the legal definition. In addition, brain death cannot be determined unless there is evidence of severe brain injury sufficient to cause death.

There is no recovery from brain death. Before clinical testing for brain death can even begin, other causes of coma such as drugs, high or low blood sugar levels and abnormal electrolyte levels must be ruled out. There must also be a minimum of four hours observation and mechanical ventilation, during which the patient is completely unresponsive to any external stimuli (Australian and New Zealand Intensive Care Society, 2014).

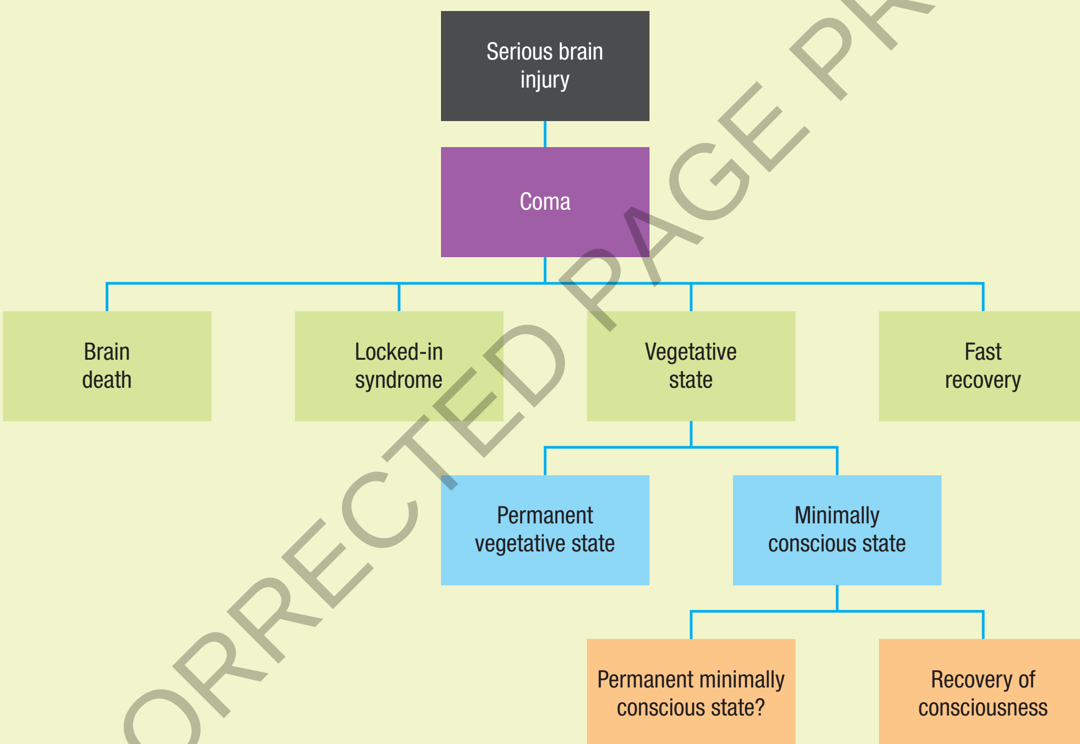


FIGURE 8.6 Different conditions may follow severe brain injury. Often, coma lasts for a couple of days and once the patients open their eyes, they evolve into a vegetative state. Then they may enter a minimally conscious state after showing some signs of consciousness and eventually they recover full consciousness. In rare cases, a person may develop locked-in syndrome, a nearly complete paralysis of the body's voluntary motor responses.

Source: Gosseries, et al., (2011). Disorders of consciousness: Coma, vegetative and minimally conscious states. In D. C. Cvetkovic & I. Cosic (Eds.), *States of consciousness — Experimental insights into meditation, waking, sleep and dreams* (pp. 29–55). Verlag Berlin Heidelberg: Springer.

LEARNING ACTIVITY 8.2

Recognising different states of consciousness and levels of awareness

People travelling on a plane from Melbourne to Singapore may each experience different states of consciousness.

Consider the list below and indicate where each person would be on the consciousness continuum in figure 8.4.

- Person 1: a pilot who is monitoring their cockpit instruments
- Person 2: a teacher who is thinking about her holiday and who has just finished her third alcoholic drink
- Person 3: a 12-year-old playing a video game
- Person 4: the mother of a two-year-old child who is watching the inflight movie while simultaneously looking after her child
- Person 5: a tertiary student gazing aimlessly out the window
- Person 6: an anxious passenger who has taken a 'sleeping pill' and can be heard snoring.

Where would you place yourself on the continuum right now?

LEARNING ACTIVITY 8.3

Review questions

1 Define consciousness, with reference to internal and external factors.

2 In what ways is consciousness personal, subjective, continuous and changing?

3 Explain the term state of consciousness.

4 What changes typically occur as a result of a change in a person's state of consciousness?

5 Could we experience two different states of consciousness simultaneously? Explain your answer.

6 (a) Why is consciousness considered to be a psychological construct?
(b) Give three examples of other psychological constructs.

7 (a) Box 8.1 describes a vegetative state, a minimally conscious state and locked-in syndrome. Where would you place each of these on the consciousness continuum?
(b) Box 8.1 also describes brain death. Explain whether this condition can be placed on the consciousness continuum.

LEARNING ACTIVITY 8.4

Reflection

Comment on whether non-human animals have consciousness and criteria that could be used to determine this.

NORMAL WAKING CONSCIOUSNESS AND ALTERED STATES OF CONSCIOUSNESS

Psychologists often distinguish between two broad categories of consciousness called normal waking consciousness and altered states of consciousness.

Normal waking consciousness refers to the states of consciousness associated with being awake and aware of objects and events in the external world, and of one's sensations, mental experiences and own existence. As described by William James, normal waking consciousness is constantly changing. However, despite this changing experience, our perceptions and thoughts continue to be organised and clear, and we remain aware of our personal identity — who we are. We also perceive the world as real and we maintain a sense of time and place.

As shown in figure 8.4, normal waking consciousness is not one single state, as there are varying levels or 'degrees' of awareness when we are awake. Generally, normal waking consciousness includes all states of consciousness that involve heightened awareness. This does not mean, however, that all our waking time is spent in the same state of consciousness. We continually shift between different states, and therefore levels of awareness, within normal waking consciousness.

Most people spend about two-thirds of each day in normal waking consciousness during which there are variations in mental awareness as streams of information flow in and out of awareness. Arbitrary dividing lines cannot be drawn between different states of waking consciousness to clearly indicate when one state starts and ends. However, when changes in mental awareness occur to the extent that you can notice differences in alertness and your responsiveness to internal and external stimuli, you may have entered an altered state of consciousness (Glicksohn, 1991).

The term **altered state of consciousness (ASC)** is used to describe any state of consciousness that is distinctly different from normal waking consciousness in terms of level of awareness and experience. In an ASC, mental processing of internal and external stimuli shows distinguishable, measurable changes. For example, self-awareness, emotional awareness and perceptions of time, place and one's surroundings may change. In addition, normal inhibitions or self-control may weaken (Martindale, 1981; Reisberg, 2013).

Psychologists also distinguish between naturally occurring and induced altered states of consciousness. Some ASCs, such as sleep, daydreaming and dreaming, are a normal part of our lives and occur **naturally** in the course of our everyday activities without the need for any aid. For example, each day, we experience natural changes in levels of alertness and awareness as we go through cycles of wakefulness, drowsiness and sleep. Other ASCs do not occur naturally and are instead **induced** — they are intentionally achieved by the use of some kind of aid, for example, through meditation, hypnosis, alcohol ingestion or by taking certain medications or illegal drugs. Some psychologists also describe altered states that are induced unintentionally due to an accident, disease or some other disorder. For example, brain trauma from a blow to the head can produce concussion or a comatose state and a medical condition such as epilepsy produces recurring seizures that alter conscious experience.

FIGURE 8.7

There are many reasons why an individual may deliberately try to achieve an ASC. For example, meditation is a useful technique to induce a state that helps people relax or manage stress. Hypnosis may be practiced as part of therapy; for example, in trying to help someone deal with fear of flying or to give up smoking. Alternatively, some people use medications and illegal drugs to reduce pain, for psychological pleasure or as an escape from the pressures of their life.

Naturally occurring and induced ASCs are not necessarily mutually exclusive. Some naturally occurring states may be induced. For example, sleep is naturally occurring and can be purposely induced with medication that promotes drowsiness.

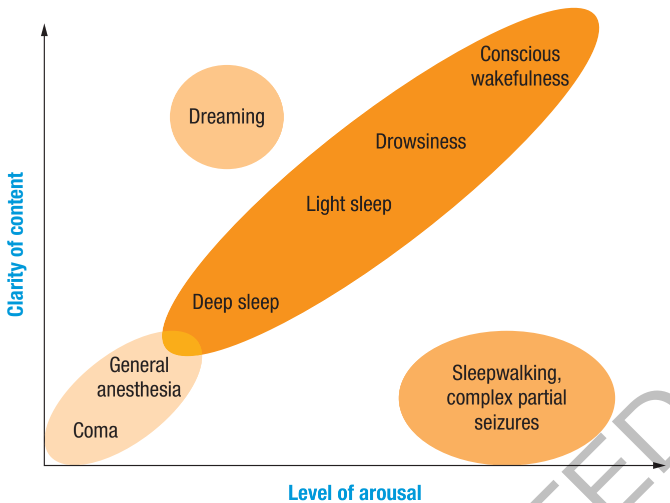


FIGURE 8.8 Some researchers have described a relationship between the level of awareness and the clarity of the contents of consciousness.

Source: Based on Gosseries, et al., (2011). Disorders of consciousness: Coma, vegetative and minimally conscious states. In D. C. Cvetkovic and I. Cosic (Eds.), *States of consciousness — Experimental insights into meditation, waking, sleep and dreams* (p. 31). Verlag Berlin Heidelberg: Springer.

Role of attention

Researchers often use attention as a measure of awareness and as a way of distinguishing between different states of consciousness. **Attention** is a concentration of mental activity that involves focusing on a specific stimulus while ignoring and therefore excluding other stimuli. Generally, the more attention, the higher the degree of awareness and vice versa. States of consciousness within the range of normal waking consciousness at the top end of the continuum involve more awareness and therefore require more attention than altered states of consciousness at the lower end of the continuum.

In normal waking consciousness, our attention can be focused either on *internal* thoughts or feelings (e.g. how tired you feel) or on *external* stimuli (e.g. what the person sitting next to you is saying). The focus of attention is like a spotlight that can be moved around. A shift in the focus of your attention, and therefore conscious awareness, can be intentional, such as when you concentrate on listening to arrangements for meeting friends. However, a shift in the focus of attention more often occurs without our being aware of it (LaBerge, 1995). For example, when you are focused on a teacher's explanation and the person sitting next to you starts talking to you, the focus of your attention will usually shift to their comments, even if only for a second or two.

Researchers also distinguish between selective attention and divided attention.

Selective attention

Selective attention involves choosing and attending to a specific stimulus to the exclusion of others. The concept illustrates the fact that at any given moment the focus of our awareness is on only a limited range of all that we are capable of experiencing. This occurs for an internally sourced event such as the perception of a pain in the foot or an externally sourced event such as watching a car drive past. Research studies on selective attention have shown that people often notice, and therefore become aware of, very little of the information that is not attended to (Milliken et al., 1998).

What factors determine whether we will attend to a particular stimulus during normal waking consciousness? It seems that we are more likely to attend to a stimulus if it is important to us, if it changes in some way or if it is novel.

If a stimulus is *personally* important to us, we are more likely to take notice of it. Suppose you are at a party. Loud music is playing and you are surrounded by many conversations. Despite being totally involved in one conversation, your attention is likely to be automatically drawn to a different conversation if you hear your name being mentioned. This commonly occurring experience is known as the 'cocktail party phenomenon' (Wood & Cowan, 1995). Our attention is also attracted by any *changes* in stimulation or the introduction of a *novel* stimulus; that is, a stimulus that is new or unusual in some way. This may explain why many television and radio advertisers pitch their commercials at a higher or lower volume than the programs they interrupt.

If our attention is selective, does that mean we take in no other information presented to us when our attention is completely focused on one thing? For example, during the first class on Monday morning your attention may be selectively focused on hearing what happened at a weekend party. However, you

FIGURE 8.9 <caption TBA>

may still process some of what the teacher is saying or doing with the rest of the class, which is selectively attending to what the teacher is saying. You may be aware that you need to have your book open at a particular section, or that you need to be copying down some questions from the board even if you don't know what the questions actually ask. Thus, even when your attention is focused on one thing, you are still capable of reacting to other stimuli. This suggests that we can process some information outside conscious awareness.

Divided attention

As we begin to move down the consciousness continuum, the level of attention required is generally not as focused or selective. For example, in normal waking consciousness, people are often able to divide their attention among competing stimuli, such as washing a car while listening to the radio and watching their children playing. **Divided attention** refers to the ability to distribute our attention and undertake two or more activities simultaneously.

It seems that our ability to divide our attention and 'multitask' depends on how much conscious effort is required for the various tasks in which we are engaged. In turn, this depends on the similarity of the tasks, their complexity and how accomplished, or 'experienced', we are at doing them. Research findings indicate that our perceptual systems can more competently perform tasks requiring divided attention tasks when the tasks are sufficiently similar, not complex, well known and therefore do not demand considerable mental effort. Often, especially for more complex tasks, we may think we are using divided attention but we are actually shifting attention from one task to another.

In one experiment, British psychologist John Duncan (1993) required participants to make two simultaneous judgments about an object that was visually presented to them on a screen. They were required to both identify the object and determine its location on the screen. Generally, participants were able to complete both tasks with few errors. However, the rate of errors increased significantly when participants were required to make two simultaneous judgments about two different objects, such as the location of each object. These results indicate that performing a complex task requires selective attention and a higher level of awareness than a simple or familiar task requires.

To test your ability to divide your attention between two tasks, try simultaneously tapping three times on the table with your left hand while at the same time tapping four times on the table with your right hand. Most people are unable to successfully divide their attention between these tasks without considerable practice.

Understanding the limits of our attention has become important in the debate about the use of mobile phones while driving. Research findings support the view that using a mobile phone while driving, whether handheld or not, distracts the driver's attention. If the driver's attention is divided between two tasks, one or both of which demand considerable attention (such as when manually dialling a phone number or texting), there is a significant increase in the likelihood that the driver will fail to notice a potentially dangerous situation in time to respond and avoid an accident (McKnight & McKnight, 1993; Royal Society for the Prevention of Accidents, 2016).

FIGURE 8.10 Using a mobile phone while driving requires divided attention to simultaneously perform two relatively complex tasks and puts the driver at risk.

BOX 8.2

Research on selective attention

To test selective attention, American psychologists Ulric Neisser and Robert Becklen (1975) had research participants view a video with two superimposed scenes showing overlapping events occurring at the same time. One scene showed two people playing a hand-slapping game (as in figure 8.11a). The other scene showed three people passing a basketball to each other.

Neisser and Becklen used an independent-groups experimental research design. Each participant was randomly allocated to one of two entirely separate ('independent') groups. Each group was asked to watch either the hand-slapping or basketball game.

The participants in the group that watched the hand-slapping game were required to press a response key whenever the people in the game slapped hands. Those watching the basketball game were required to respond in the same way whenever the basketball was passed.

The results showed that participants in both groups were able to selectively attend to the designated stimulus and effectively block the other stimuli that were present. Their 'attention filtering' processes were so successful that of the 24 participants who focused on the basketball game, only one noticed that the hand-slappers had finished their game and were shaking hands. When the experimenter replayed the videotape, the participants reported that they were surprised at what they had missed.

According to Neisser and Becklen, their results suggested that information may enter or be excluded from our consciousness through the process of selective attention.

FIGURE 8.11 Figures (a) and (b) are drawings from scenes in the two videos in the Neisser and Becklen (1975) experiment. Figure (c) shows the two scenes superimposed, as seen by research participants.

LEARNING ACTIVITY 8.5

Review questions

1. Define the meaning of
   (a) normal waking consciousness
   (b) altered state of consciousness (ASC).
2. In what main ways is an ASC different from normal waking consciousness?
3. Can an ASC be experienced during normal waking consciousness? Explain your answer with reference to an example.
4. State two naturally occurring ASCs and two purposely induced ASCs.
5. When we drift into dream sleep from non-dream sleep, do we shift into an ASC? Explain your answer.
6. An employer is concerned that one of her employees has been arriving at work in an altered state of consciousness and is not in a fit state to operate the machinery for which he is responsible. She is not sure what the characteristics of different ASCs are and wants to be more confident of her information before discussing the issue with him. List three characteristics of ASCs that may be helpful for the employer to know.
7. Distinguish between selective and divided attention with reference to an example not used in the text.

LEARNING ACTIVITY 8.6

Reflection

Comment on whether an ASC is simply any state of consciousness 'which is not normal waking consciousness'.

LEARNING ACTIVITY 8.7

Evaluation of research by Neisser and Becklen (1975) on selective attention

Evaluate the research on selective attention conducted by Neisser and Becklen (1975) described in box 8.2 on page 00. Your evaluation should respond to the following:

1. Formulate a research hypothesis for the experiment.
2. Identify the operationalised independent and dependent variables in the experiment.
3. Suggest why an independent groups design was used for the experiment, rather than a repeated measures or matched participants design.
4. Briefly state the results that were obtained.
5. Briefly state the conclusion(s) drawn by the researchers on the basis of the results obtained.

METHODS USED TO STUDY CONSCIOUSNESS

Psychologists may use a variety of techniques to study states of consciousness and identify specific responses associated with different states. The most commonly used techniques can be organised in four different categories: measurement of physiological responses, measurement of performance on cognitive tasks, self-reports and video monitoring. The techniques can be used independently or in combination. We consider examples from each category.

Measurement of physiological responses

Measurements of physiological responses enable researchers to obtain data on bodily changes and responses during various states of consciousness. These have provided valuable information on levels of alertness and underlying bodily changes that occur in different states. Three commonly measured physiological responses are changes in brain wave patterns, muscle activity and eye movements.

Electroencephalograph (EEG)

In 1924, German psychiatrist Hans Berger developed the electroencephalograph (*electro-en-sef-uh-low-graf*) to record and analyse electrical activity of the brain associated with different behavioural responses and mental processes (Springer & Deutsch, 1998). An **electroencephalograph**, or **EEG**, is a device that detects, amplifies and records general patterns of electrical activity of the brain over a period of time.

The electrical activity spontaneously and continuously produced by the brain's neurons, particularly neurons in the cerebral cortex just below the scalp, can be detected outside the skull. This is achieved using small electrodes that are attached to the surface of the scalp at the top and sides of the head. Alternatively, a participant may be required to wear a head cap with prepositioned or adjustable electrodes to suit individual requirements.

Each electrode simultaneously detects and receives signals from many thousands of neurons that are activated in the vicinity and the EEG averages this out. The EEG then amplifies and translates the activity in cortical areas beneath the electrodes into a visual pattern of brain waves. The brain waves are recorded and displayed as a graph on a computer monitor or as a moving sheet of graph paper (see figure 8.12). These EEG records are called *electroencephalograms*. The brain waves in the graph illustrate activity that can be matched to brain areas that correspond with the location of electrodes.

The rate, height, and length of brain waves vary depending on the brain area being studied, and every individual has a unique and characteristic overall brain-wave pattern. Age and the current state of consciousness also cause changes in wave patterns.

Since the brain may produce different activity in different areas, multiple electrodes are used. The more that are used, the more detailed the brain wave data and the overall picture of the brain's electrical activity. The placement of the electrodes is also critical to the reading of the data. In most cases, their number and position across the skull matches an international standard called the *10-20 system*. This was developed as a standardisation procedure so that the results of different patients and research participants can be compared to each other and to support replication of EEG assessments and research studies.

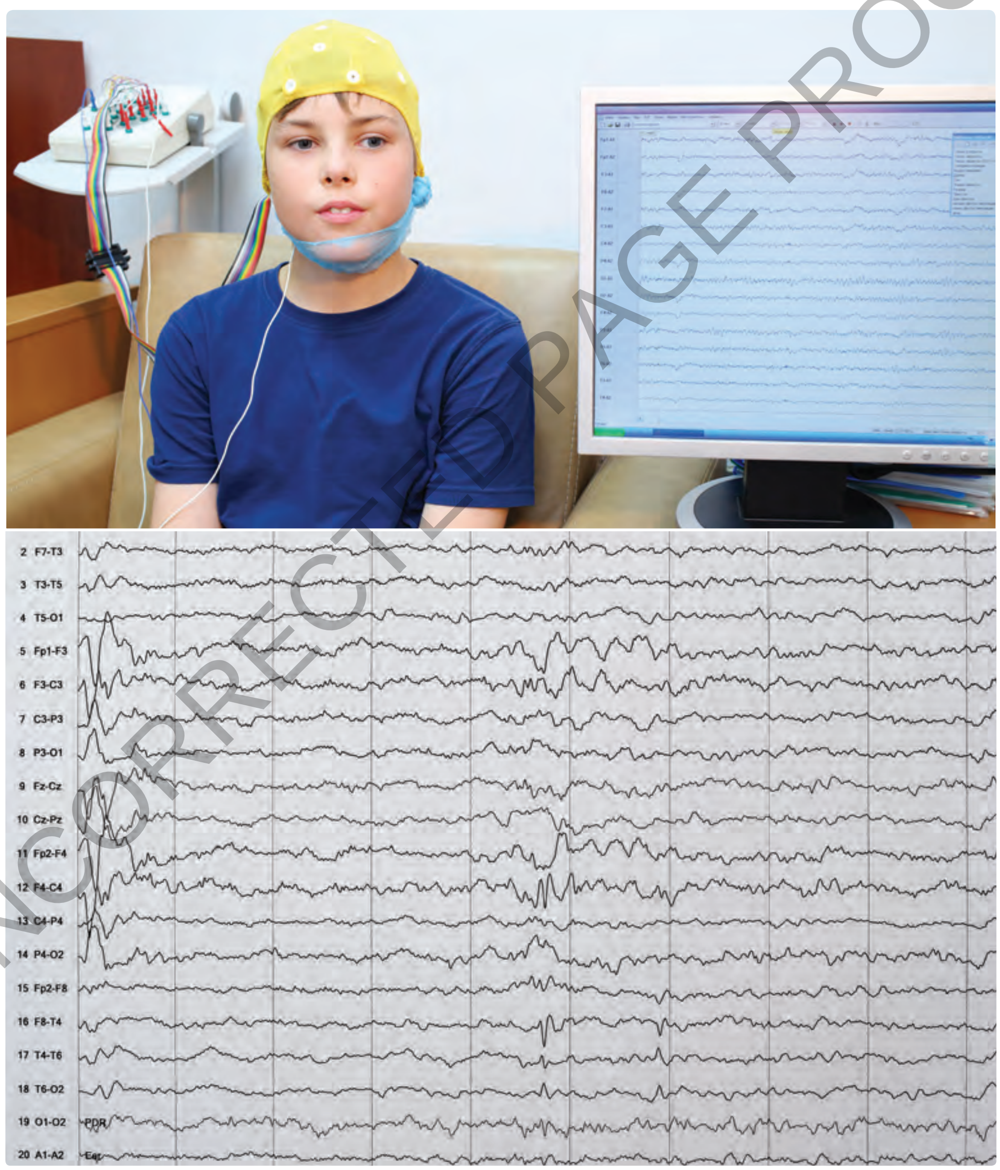
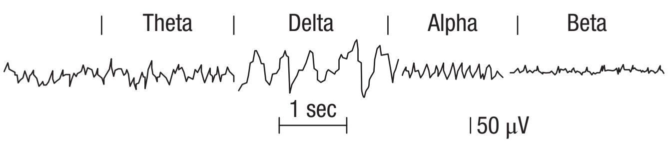


FIGURE 8.12 An EEG records the electrical activity at different locations in a participant's brain through precisely located electrodes attached to the scalp. Each electrode detects activity at a different point on the skull and is displayed as a row of EEG data.

Brain wave patterns shown in EEG recordings vary in frequency and amplitude. *Frequency* refers to the number of brain waves per second. A pattern of *high-frequency* brain wave activity is faster and therefore has *more* brain waves per unit of time. A pattern of *low-frequency* brain wave activity is slower, and therefore has *fewer* brain waves per unit of time.

The *amplitude* or intensity of brain waves is measured in microvolts and can be visually judged by the size of the peaks and troughs of the waves from a baseline of zero activity. *High-amplitude* brain waves have *bigger* peaks and troughs, while *low-amplitude* brain waves have *smaller* peaks and troughs.

Four commonly described brain waves are named after letters in the Greek alphabet — beta, alpha, theta and delta. These waves are shown below in an order ranging from highest to lowest frequency. Beta have the highest frequency and lowest amplitude, whereas delta have the lowest frequency but highest amplitude.



EEG recordings indicate that brain wave patterns, or 'rhythms', change as level of alertness changes within a state of consciousness. Distinguishable brain wave patterns have also been associated with altered states of consciousness (see figure 8.13). The predominance of different brain wave patterns varies with age. For example, the EEGs of infants and children are normally characterised by a greater mixture of brain waves than is found in adults. We consider typical patterns and when they are most commonly observed under normal circumstances.

A predominantly *beta brain wave pattern* is associated with alertness and intensive mental activity during normal waking consciousness. For example, when we are awake, attentive to external stimuli and actively concentrating or thinking, our brain's electrical activity is at its highest. Beta waves are also present during states of tension, anxiety, threat, fear and when dreaming during a period of rapid eye movement sleep (Jovanov, 2011). The beta pattern comprises high-frequency (fast) and low-amplitude (small) brain waves. These are the fastest of the waves.

When we are awake and alert but mentally and physically relaxed and internally focussed, the EEG shows a predominantly *alpha brain wave pattern*. For example, if you complete a mentally active task and sit down to rest and calmly reflect on what you did, your brain waves will be mostly alpha, especially if you close your eyes. Typically, the alpha pattern is regular or 'rhythmic' (rather than irregular or 'jagged') in appearance, with a medium to relatively high frequency (but slower than beta waves) with low amplitude (but a slightly larger amplitude than beta waves). Alpha waves in humans mostly originate in the visual cortex area in the occipital lobe at the back of the brain. If a relaxed person with eyes closed is disturbed or opens their eyes, alpha waves abruptly stop.

A predominantly *theta brain wave pattern* is most commonly produced when we are very drowsy, such as when falling asleep or just before waking. They may also be produced when awake and engaged in creative activities, during dream-like visual imagery, when excited and when deeply meditating (Jovanov, 2011; Tatum, 2014). Relatively little theta activity is ordinarily recorded in adults during normal waking consciousness when compared with the other brain waves (but it is common in young children during normal waking consciousness). The theta wave pattern has a medium frequency and some high-amplitude (large) waves mixed with some low-amplitude (small) waves.

Delta waves are most commonly associated with deep, dreamless sleep or unconsciousness. They begin to appear in stage 3 of non-rapid eye movement sleep. In stage 4, during which we experience the deepest sleep, there is a predominantly *delta brain wave pattern*. Stage 4 occurs before a period of rapid eye movement sleep that is associated with dreaming. Delta waves are usually considered normal when observed in the very young and elderly during waking states. They are predominant in waking states throughout infancy and early childhood, decreasing to less than 10% of waking time by about age 10 years (Tatum, 2014). Delta waves have a pattern of low-frequency (slow) and high (large) amplitude. They are very slow and the slowest of all the brain waves.

Brain wave patterns are used in conjunction with other physiological or psychological measures to help identify and describe an individual's level of alertness and the associated state of consciousness. The distinctive brain wave patterns also make the EEG a reliable technique for determining abnormal brain activity, for monitoring changes within a state of consciousness (such as sleep stages), and to identify different states of consciousness. A living person's brain always has electrical activity. Still slower waves than delta appear during anaesthesia or when a person is in a coma. When 'brain death' occurs, the EEG becomes a flat line. In some cases, severe drug-induced sedation can cause a flat EEG.

The EEG is useful in providing general, or 'overall', information about brain activity in real time without being invasive. Since its development in the 1920s, it has provided valuable information about different levels and types of brain wave activity associated with various thoughts, feelings and behaviours in different states of consciousness.

The EEG is also widely used to assist with the diagnosis and study of various brain-related medical conditions, including brain damage and neurological disorders, particularly epilepsy which is characterised by uncontrollable bursts of brain activity. Different types of brain waves are seen as abnormal only in the context of variations from what would normally be expected from the location of the waves and for a person's age, their state of consciousness and level of alertness when the EEG is conducted.

In general, disease typically increases slow activity, such as theta or delta waves, but decreases fast activity, such as alpha and beta waves. Additionally, the theta waves normally found in adults during drowsiness and sleep are also normal in children when awake, and delta waves commonly occur during normal waking consciousness in infancy but not in adulthood (Colrain, et al., 2010).

A limitation of the EEG is that it poorly measures neural activity that occurs below the outer layer of the brain (i.e. the cortex). Nor does it provide detailed information about which particular structures of the brain are activated and what their specific functions might be, especially areas beneath the cortex. Multiple electrodes are positioned across the top of a relatively large area of the brain and it can be difficult to pinpoint exactly where in the brain the activity is coming from. Specific changes in brain wave activity do occur in response to the presentation of a particular stimulus, such as a flash of light, but the changes in brain wave activity can be hidden by the overall background activity of the brain. Furthermore, the strength of the electrical activity at its source is reduced after having travelled through the thick bone structure of the skull. Therefore, the EEG merely provides a summary of all the activity of neurons firing within different areas of the brain. Using an EEG to understand overall brain function has been likened to studying the activity of a car engine by listening to the hum of the motor (Myers, 2007).

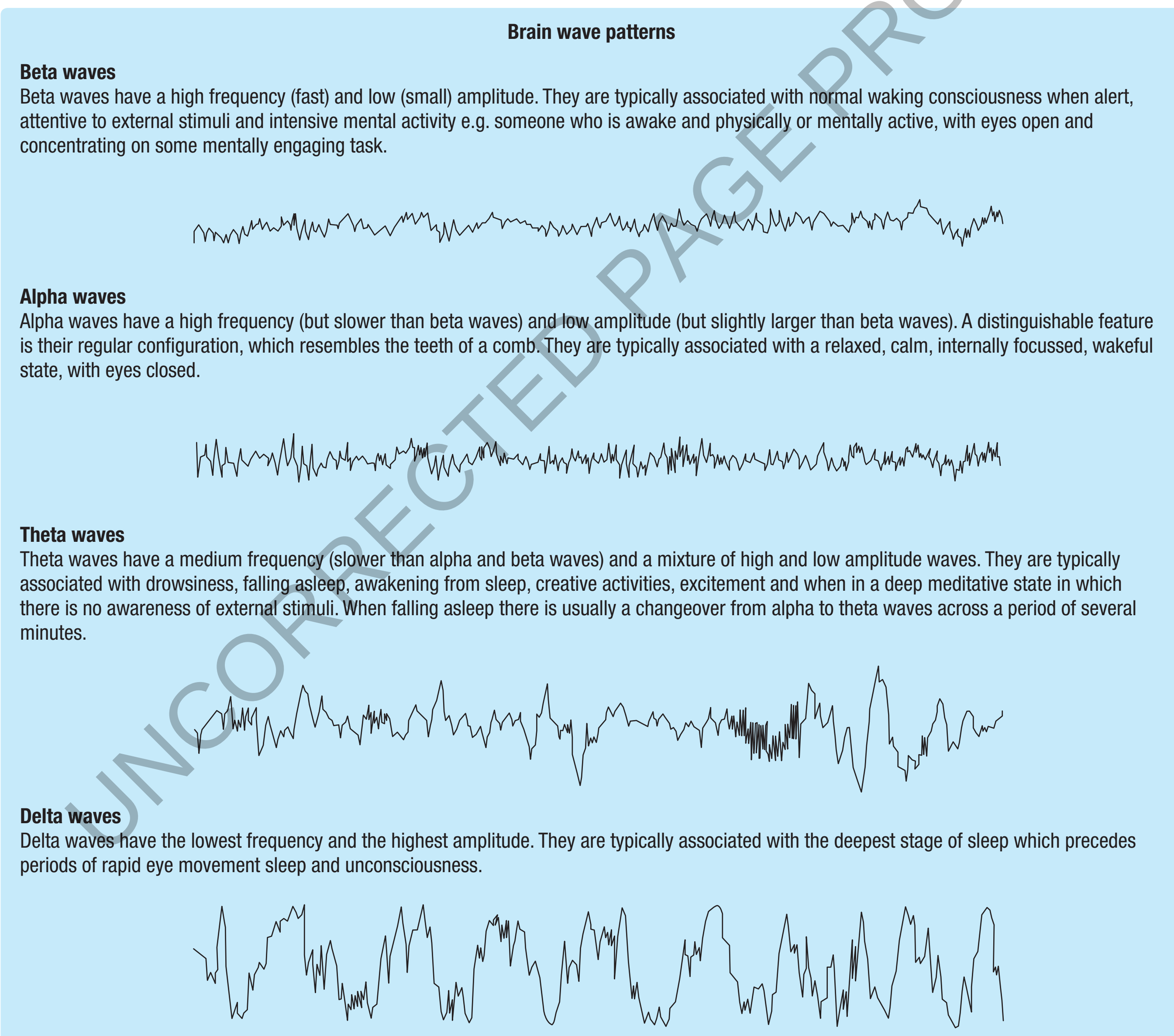


FIGURE 8.13 Four brain wave patterns in an order ranging from fastest activity (beta) to slowest activity (delta).

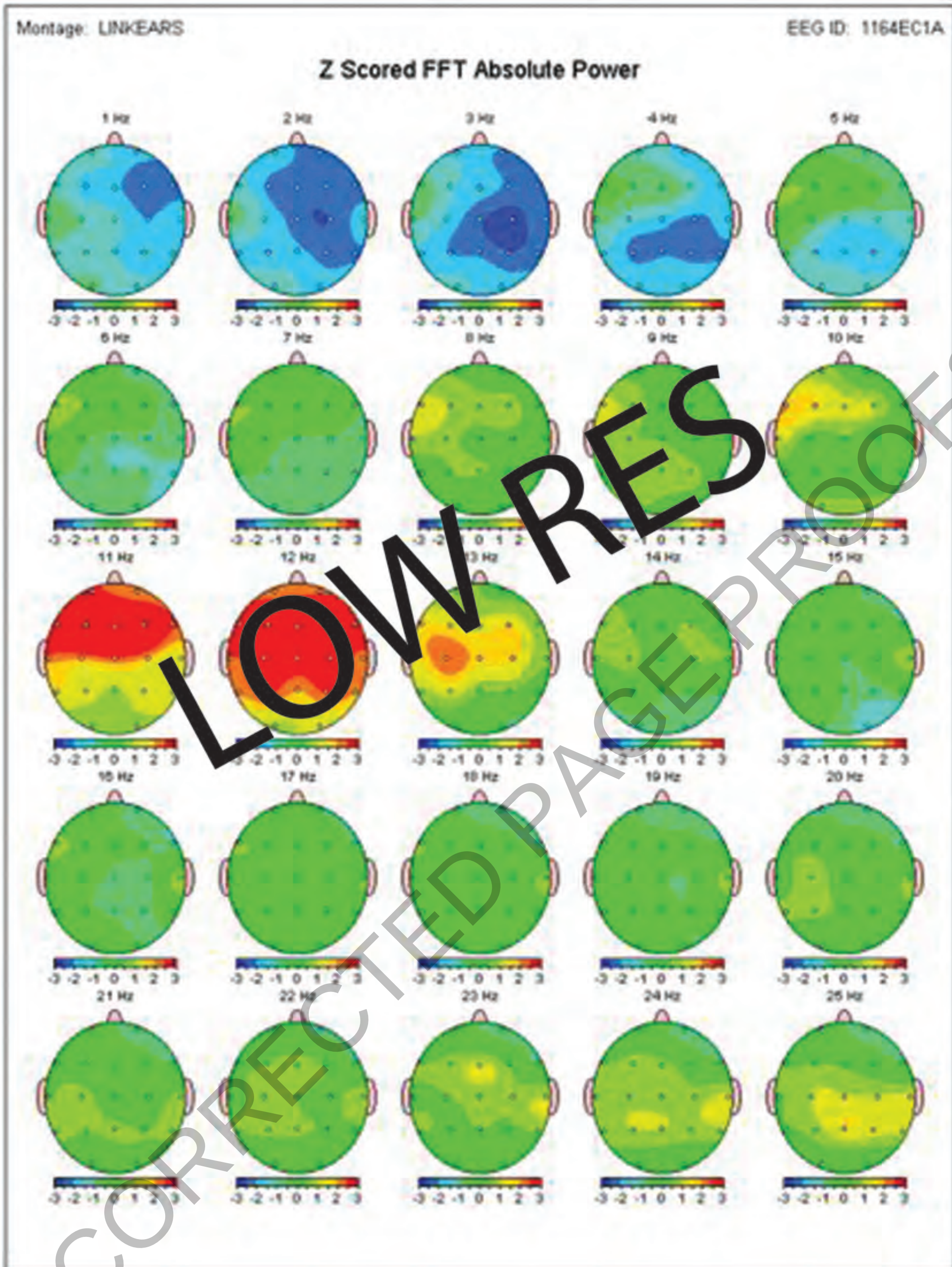


FIGURE 8.14 An extension of the EEG technique, called *quantitative EEG* (qEEG), involves capturing and processing the EEG signals in a digital format. This enables mathematical calculations and comparisons of the different rows of data for a more precise diagnosis of subtle changes in brain function. The result is displayed as a topographic image of the head with different colours representing electrical activity in different brain areas.

LEARNING ACTIVITY 8.8

Reflection

Does conscious awareness or the brain activity enabling awareness occur first? Perhaps they are a single event that occur together? What do you think? Explain your answer. Can you suggest a way in which this could be experimentally investigated?

Brain wave patterns due to drug-induced, altered states of consciousness

A **drug** is any substance that can change a person's physical and/or mental functioning. Certain types of drugs can induce an altered state of consciousness and changes in brain wave patterns. Two broad categories of drugs that can initiate such changes are called stimulants and depressants. Drugs within each of these categories have opposite effects on central nervous system activity, as indicated by the category names — they either 'stimulate' or 'depress' activity.

Like all other drugs, stimulants and depressants exert their effects by influencing specific neurotransmitters, receptors or by chemically altering neuronal function in other ways. Their potential effects are further influenced by a range of variables such as:

- the type of stimulant or depressant that is taken
- the dose (amount) and potency (strength)
- personal characteristics of the individual e.g. body weight, physiology, sex, age, health and wellbeing, prior use, personality, mood, expectations
- method of administration e.g. oral, injection, inhalation, skin patch
- when administered e.g. daytime or night time before sleep
- whether other drugs are also taken
- context e.g. alone or with others, social or medical situation.

There is an interplay between these variables that influences psychological and physiological responses to a drug. Moreover, specific drug effects can vary from person to person and even for the same person in different situations. A drug's effects can also change as a person develops a tolerance to the relevant chemical. However, some effects are reasonably predictable. In this section, we refer to the *typical* effects of stimulants and depressants, focussing on overall changes in levels of alertness as indicated by brain waves patterns.

Stimulants

Stimulants are drugs that increase activity in the central nervous system and the rest of the body. They therefore have an alerting, activating effect.

Stimulants range from mild, widely available drugs, such as *caffeine* which is found in coffee, tea, chocolate, cola, energy drinks and some non-prescription medications, and *nicotine*, which is found in cigarettes and other tobacco products, to strong, carefully regulated or illegal drugs, such as *amphetamines*, *cocaine* and *ecstasy*.

Some types of amphetamines are legally prescribed by doctors to treat conditions such as attention deficit hyperactivity disorder (ADHD) or the sleep disorder narcolepsy which involves excessive sleepiness. Amphetamines that can be legally prescribed are often accessed by someone without the relevant symptoms and misused to 'get high'. Other types of amphetamines such as 'speed' and the more potent form called 'ice' (crystal methamphetamine) are produced and sold illegally.

FIGURE 8.15 Stimulants increase activity in the central nervous system and the rest of the body. Caffeine and nicotine are widely available stimulants. Others are carefully regulated or illegal drugs, such as amphetamines and ecstasy.

Even mild stimulants, especially when taken in large amounts, are capable of altering conscious experience. Stimulants may alter attention, mood, emotional awareness, self-control, time orientation, memory, judgment, decision making and other cognitive processes. For example, possible psychological effects of a powerful stimulant such as amphetamine include increased alertness, focus, confidence, feelings of wellbeing and motivation. People using an amphetamine will often become happier and more confident, talkative and sociable. Many report clearer thoughts and perceptions (Australian Drug Foundation [ADF], 2016a; McKim & Hancock, 2012).

Amphetamines also stimulate the sympathetic nervous system, producing physiological changes not unlike fight–flight reactions to a threat or stressor. For example, blood pressure and heart rate increase, arousing the body and contributing to the overall energising effects. The energising effects of amphetamines can reduce feelings of tiredness and have often been used by people who want to do something active, like dance, for long periods of time. As amphetamines can increase energy levels, motivation and focus, they are also used as a performance enhancer. For instance, some people use them to temporarily increase alertness, maintain wakefulness or delay sleep to work for long periods of time.

As with all drugs that are misused or abused, stimulants will have side-effects. A 'speed crash' always follows the high and may leave the person feeling nauseous, irritable, depressed and extremely exhausted for days. At very high doses and frequent heavy use, amphetamine use can result in 'amphetamine psychosis', characterised by hallucinations, paranoid delusions and out of character aggressive or violent behaviour. Psychotic symptoms are especially evident in people who abuse methamphetamine ('ice') (Advokat, Comaty & Julien, 2014; ADF, 2016a; drugscience, 2016a).

There are also measurable changes in brain wave patterns associated with stimulants and these tend to occur relatively quickly, especially for the more potent stimulants. Stimulants increase physiological arousal and there is a corresponding excitatory pattern of brain wave activity. Generally, when compared to the baseline brain wave of activity of normal arousal during normal waking consciousness under normal everyday conditions that would be expected for the individual's age, there is an increase in higher frequency (faster) activity and a decrease in lower frequency (slower) activity. More specifically, there is a pattern of increased beta wave activity and decreased delta, alpha and theta activity. The more potent the stimulant, the longer these changes are likely to persist, and vice versa (Kennedy, 2016a; Saletu, Anderer & Saletu-Zyhlarz, 2006, 2010).

FIGURE 8.16 <Caption to come>

Depressants

Depressants are drugs that decrease activity in the central nervous system and the rest of the body. Generally, their effects result in a state of calm, relaxation, drowsiness, sleep or anaesthesia as doses of the drug increase. They do not necessarily make a person feel 'depressed'.

As with stimulants, depressants range from mild, widely available drugs through to strong, carefully regulated or illegal drugs. All reduce alertness, environmental awareness, responsiveness to sensory stimulation, cognitive functioning and physical activity to some extent. Loss of self-control is common. In small doses they can cause a person to feel more relaxed and less inhibited. In larger doses they can cause unconsciousness and death (ADF, 2014).

Depressant drugs frequently multiply the effects of other CNS depressants. Thus, the depressant effects that are observed in a person who has taken more than one drug is greater than would be predicted if the person had taken only one. Such intense CNS depression is often unpredictable and unexpected, and it can lead to dangerous or even fatal consequences (Advokat, Comaty & Julien, 2014).

Barbiturates and *benzodiazepines* are the two major categories of depressant drugs used as medications, most commonly to aid sleep and sometimes to alleviate symptoms of anxiety or seizure activity. Often these drugs are referred to as sleeping pills and tranquillisers or sometimes just as sedatives. Some well-known barbiturates are secobarbital (brand name Seconal) and pentobarbital (Nembutal). Among the most common benzodiazepines prescribed in Australia are diazepam (Valium), temazepam (Normison), oxazepam (Serapax) and nitrazepam (Mogodon). Flunitrazepam (Rohypnol) is a benzodiazepine related to Valium (about 10 times more potent) that is illegally used to spike drinks. Drink spiking occurs when a person deliberately adds a drug to a drink without the knowledge of the person who will be drinking it (ADF, 2015a).

Opiates and their derivatives are another class of depressants. These include *heroin*, *morphine* and *codeine* which are primarily used as analgesics to provide pain relief. They are attractive to people seeking to induce an altered state of consciousness because they produce

FIGURE 8.17 Depressants decrease activity in the central nervous system and the rest of the body. Alcohol is a widely available depressant. Others include medications such as sedatives that aid sleep or alleviate anxiety and various analgesics that provide pain relief but may also be misused or abused recreationally to induce a relaxed or pleasant ASC.

feelings of relaxation and euphoria. Opiates have long been abused in many cultures. When injected, the user feels an immediate 'rush' — a strong wave of pleasurable relaxation and relief from anxiety. The user may go 'on the nod' — shifting back and forth from feeling alert to drowsy. With large doses, the user cannot be awakened. Breathing slows down and death may occur. In some cases, severe drug-induced sedation can cause a flat EEG.

Alcohol is also classed as a depressant, which is contrary to popular belief given that it is commonly used to achieve a positive or elevated mood. Brain areas affected by alcohol include those that control inhibition, thought, perception, attention, judgment, memory, sleep and coordination. Within the nervous system, alcohol can initially have a stimulant phase followed by a more prolonged depressant phase (Hendler, et al., 2013). Higher levels of alcohol inhibit or slow brain functioning, with the depressant effects seen behaviourally. For example, alcohol dampens motor and sensory areas and makes perceptual judgments, co-ordination and balance more difficult. Risky behaviour is also a common result of alcohol use because areas involved in decision-making and self-control are dampened. High enough concentrations can cause the user to eventually lose consciousness. The effects of alcohol consumer together with another drug(s) — including over-the-counter or prescribed medications — can be unpredictable, dangerous and even fatal (ADF, 2016b; drugscience, 2016b).

As with stimulants, various depressants designed for medical purposes are also used recreationally. People misusing or abusing depressants generally take larger doses than would be prescribed. Typically, the desired effect is an elevated mood, with bad feelings of tension or dejection replaced by a relaxed, pleasant state accompanied by lowered inhibitions.

There are also measurable changes in brain wave patterns associated with depressants. Depressants decrease physiological arousal and there is a corresponding inhibited pattern of brain wave activity. Generally, there is an increase in lower frequency (slower) activity and a decrease in higher frequency (faster) activity. More specifically, there is a pattern of reduced beta wave activity and increased delta, alpha and theta activity (Kennedy, 2016a). As with stimulants, the more potent the depressant, the longer-lasting these changes are likely to persist, and vice versa. Similarly, measurable changes depend on other usage related variables, as well as the specific procedures used by researchers conducting their EEG studies (Gunkelman, 2009; Kumar & Palatty, 2013; Saletu, Anderer & Saletu-Zyhlarz, 2006, 2010).

FIGURE 8.18 <Caption to come>

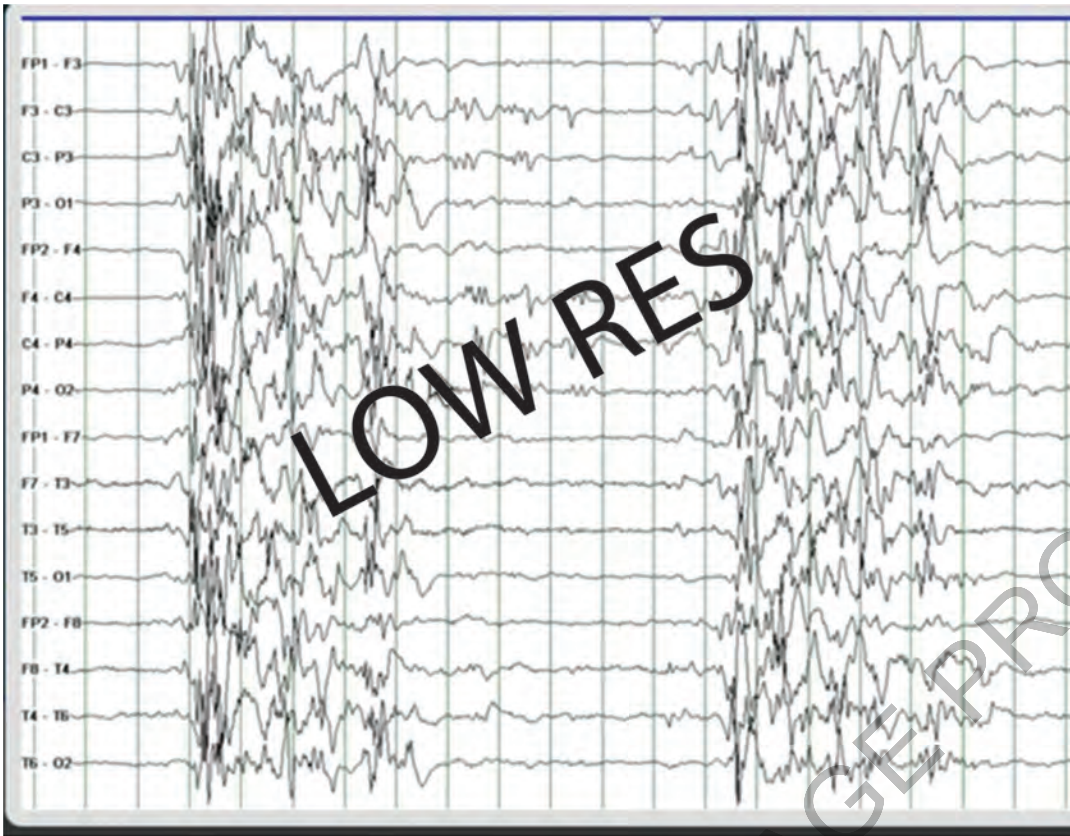


FIGURE 8.19 In high dosage or severe depressant overdose cases, the EEG may show a burst suppression pattern. This usually consists of bursts of EEG activity every 2 to 10 seconds separated by periods of suppression during which there is little or no EEG activity. This pattern can last for hours or even days depending on whether the depressant is still in present (Anderer & Saletu-Zyhlarz, 2010)

BOX 8.3

Sleeping tablets

What are sleeping tablets?
They are drugs that you take to try to get to sleep or stay asleep. Some tablets that are used to help with sleep have been specifically created for this. Other types (e.g. antihistamines) are used to treat other medical problems and feeling sleepy is a side effect.

What are some of the commonly used sleeping tablets?
Benzodiazepines — This group includes Temazepam, Mogadon, Normison and Serepax. You can only get them on prescription. They are used to treat insomnia in the short-term (usually 3–4 weeks). In the longer term they can stop working. There is also the risk of 'getting hooked' on them.

Antidepressants or antipsychotics — This group includes antidepressants (e.g. Doxepin, Endep, Dothiepin, Avanza) and antipsychotics (e.g. Seroquel or Zyprexa). They are prescription only. In most cases, they are prescribed when sleep problems occur with mental health problems.

Antihistamines — You don't need a prescription to get these from pharmacies but they're not designed as sleeping tablets. They can be very sedating and can last a long time. You can end up feeling more tired in the morning which is potentially dangerous, for example when riding a bike or driving. The effect of antihistamine such as Restavit and Phenergan tends to wear off quickly.

Important things to know about sleeping tablets

- They can only deal with sleep problems in the short term.
- You should only use them for more than four weeks on the advice of your doctor.
- They can cause side effects such as dependence.
- Taking them with other drugs or alcohol can be dangerous.
- They tend to help more to get to sleep than to stay asleep.
- If you take them every night, they might not work as well as they used to.
- There are other things that can be tried if you are having problems with your sleep

Source: Sleep Health Foundation (2016). Sleeping tablets (Fact sheet). Retrieved from http://www.sleephealthfoundation.org.au/fact-sheets-a-z/217-sleeping-tablets.html

Electromyograph (EMG)

The **electromyograph**, or **EMG**, is used to detect, amplify and record the electrical activity of muscles. EMG recordings generally show the strength of electrical activity occurring in the muscles, which indicates changes in muscle activity (movement) and muscle tone (tension). This data is obtained by attaching electrodes to the skin above the relevant muscles. Sometimes the activity in facial muscles is recorded. At other times, leg muscles, muscles on the torso (main part of the body), or a combination of these are recorded.

The records of the EMG are displayed as line graphs, similar to those produced by the EEG. They can be produced on paper or on a computer monitor.

EMG records show that there are identifiable changes in muscular activity during certain states of consciousness. For example, when falling asleep, we usually become less and less alert as we drift into deeper stages of sleep. While this is occurring, our muscles progressively relax (decrease in muscle tone). There are also distinguishable periods when our muscles may spasm (during light sleep) or be completely relaxed (during deep sleep). Overall, though, EMG measures of people during different states of consciousness indicate that the higher the level of muscular activity and tone, the more alert we tend to be and vice versa.

Electro-oculargraph (EOG)

The **electro-oculargraph**, or **EOG**, measures eye movements or eye positions by detecting, amplifying and recording electrical activity in eye muscles that control eye movements. This is done through electrodes attached to areas of the face surrounding the eyes. The records of the EOG are displayed as line graphs, similar to those produced by the EEG and EMG. They can also be produced on paper or on a computer monitor.

FIGURE 8.20 EMGs and EOGs are used to record muscle activity and eye movement during studies of consciousness, most commonly during sleep to study changes during different sleep stages, including dream periods. Electrodes attached to the skin on facial areas above muscles that control eye movements detect electrical activity of the muscles and hence eye movements. These are then amplified and recorded.

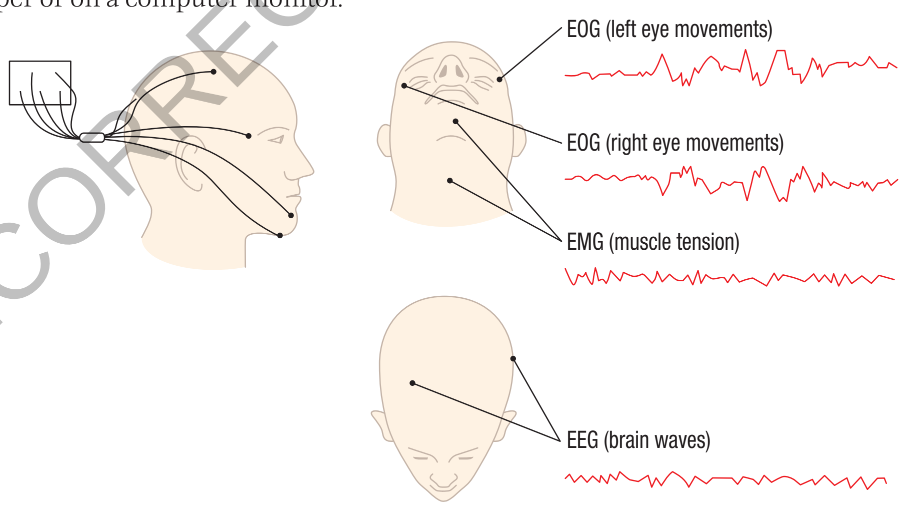


FIGURE 8.21 Three commonly measured physiological responses when studying consciousness are electrical activity of the brain, measured using an EEG; muscle tension, measured using an EMG; and eye movements, measured using an EOG. Electrodes that are strategically placed on the scalp (EEG), around the eyes (EOG) and near muscles on the face and body (EMG) detect, amplify and record patterns of activity.

The EOG is most commonly used to measure changes in eye movements over time during different stages of sleep and while dreaming. In particular, sleep research studies that have used EOGs have been of immense value in clarifying the distinction between the two different types of sleep called *rapid eye movement* sleep and *non-rapid eye movement* sleep.

LEARNING ACTIVITY 8.9

Review questions

1 Construct a table that summarises the three devices used to measure physiological responses during different states of consciousness. Headings should include: *name of device, what it measures and examples of responses associated with alertness or SOCs.*

2 (a) Explain the difference between frequency and amplitude in relation to brain waves.
(b) Which brain wave is the fastest? slowest?

3 Construct a table that summarises the frequency (slow or fast) and amplitude (large or small) of the four different kinds of brain wave patterns and levels of alertness and behaviours with which each pattern is associated.

4 For each of the following activities, state which brain wave pattern(s) would most likely be dominant —alpha, beta, theta or delta:
(a) lying on the beach, having just fallen asleep
(b) playing a video car racing game
(c) using a phone app to measure your heart rate when relaxed
(d) using visual imagery when entirely focused on a creative task
(e) naturally awakening from a normal sleep episode
(f) being woken up by an alarm mid-dream during a normal sleep episode
(g) in the deepest stage of sleep
(h) learning how to use a mathematical formula for the first time
(i) watching a Disney 'family' movie
(j) anaesthetised
(k) feeling frightened by an approaching unleashed dog
(l) feeling very drowsy and struggling to keep eyelids open
(m)feeling very elated on learning about an excellent result for an important assessment
(n) worried about being late when on the way to a job interview
(o) resting with eyes closed, just having entered a relaxed meditative state
(p) extremely relaxed in a very deep meditative state
(q) making a reflexive response to painful stimulation when in a coma.

5 Complete the following table to summarise changes in levels of alertness as indicated by changes in brain wave patterns due to drug-induced ASCs.

Drug type	Examples of drugs	Overall effect on the nervous system and body	Brain wave pattern
stimulant			
depressant			

Measurement of speed and accuracy on cognitive tasks

The EEG, EMG and EOG involve measurement of physiological responses in the study of consciousness. Researchers also study psychological and behavioural responses during different states of consciousness. This may be achieved using objective and/or subjective measures.

The speed and accuracy of responding are two commonly used objective measures. For example, a researcher may measure speed and accuracy of participants when perceiving and responding to road stimuli in a driving simulator after different periods of sleep deprivation, ranging from 30 minutes through to a day or more. Similarly, speed and accuracy may be used to assess how varying amounts of a stimulant or depressant affect performance on a cognitive task involving learning, memory, spatial processing, reasoning, decision making or problem solving. In most speed and accuracy experiments, participants complete one or more cognitive tasks (sometimes called *neurocognitive assessments*) across a number of trials and mean scores are calculated.

Measurement of **speed** typically involves response or reaction time to a stimulus — how much time elapses between the presentation of some stimulus and the individual's response to the stimulus. This is usually measured in thousandths of a second (called milliseconds). These time measures are very small but nonetheless significant. Mental events and their underlying processes when performing a cognitive task take time. Precise measurements enable researchers to pinpoint how long it takes in real time to complete them. In a driving simulator, the speed measure often involves 'perception reaction time' to unpredictable road stimuli such as traffic lights, railway level crossing signals, road signs, pedestrians and other vehicles. Many speed reactions in real world tasks involve an initial reaction time, followed by a precise movement which also contributes to the overall response time. Consequently, the researcher may take account of this aspect too.

Measurement of **accuracy** typically involves the number of correct responses and incorrect responses (errors) made by the individual. Usually, the researcher calculates the proportions of correct and incorrect responses in relation to the total number of possible responses to pinpoint accuracy. In a driving simulator study, accuracy may be measured in relation to the number of road stimuli to which the participant correctly reacts.

Speed and accuracy are considered *objective* performance measures because their scores are not subject to personal opinion or interpretation by the researcher. For example, speed can be measured using an electronic timing device which will provide exactly the same data regardless of the researcher collecting it. In addition, the data collected can be verified (confirmed) by another researcher. Similarly, accuracy can be measured in terms of responses with clear cut boundaries such as 'Yes' or 'No' and 'Present' or 'Not present' that are not open to interpretation and therefore vulnerable to personal opinion or bias. Such responses can also be electronically recorded to maintain objectivity. In many cases, measurements are computer assisted, requiring responses involving a simple tap of a key following presentation of an onscreen stimulus, a procedure which captures both speed and accuracy.

FIGURE 8.22 <Caption to come>

In a typical experiment, an aspect of consciousness and a relevant cognitive task are isolated and operationalised for study. Under different conditions involving experimental and control groups (or a repeated measures design), both the speed and accuracy of performance are then measured (often scored digitally by computer), usually multiple times (in different trials) to help ensure reliability of the results.

For example, the effects of drowsiness when awakened from deep sleep on processing verbal information in short-term (working) memory could be assessed in an independent groups experiment. Participants may be presented with anagrams (scrambled words) one at a time, then required to select the correct word for each anagram from among alternatives. They would usually be instructed to respond as quickly and accurately as possible. This would clarify requirements and also help ensure participants do not focus more on accuracy than speed, or vice versa. For each experimental condition, accuracy would depend on the number of errors and speed would be calculated as the mean of response times by all participants on each trial (sometimes assessed on correct trials only).

In some experiments, it is not uncommon for a researcher to exclude response times that are extreme and vary too much from the mean (e.g. 2.5 standard deviations) because they could be attributable to an accidental key press. In all experiments, however, both speed and accuracy scores are considered when assessing performance under different conditions. In relation to speed, faster = better performance and for accuracy, fewer errors = better performance (Glickman, Gray & Morales, 2005).

For a wide variety of real world cognitive and behavioural tasks we perform in everyday life, speed and accuracy tend to be highly related — the faster responders tend to also be more accurate, and vice versa, regardless of the type of movement required when responding. For example, in a driver drowsiness study, the required response may involve a foot movement such as pressing on a brake or accelerator pedal in a simulator rather than a hand movement. Experience on a task also tends to improve both speed and accuracy over long periods of time. For some tasks, however, we may intentionally change our performance to respond faster if necessary, but at the cost of reducing the accuracy of our response. Similarly, if high accuracy is required, then we can compromise speed and slow down our response time in order to increase our accuracy if we want to (Glickman, Gray & Morales, 2005; Proctor & Vu, 2003; Triggs & Harris, 1982).

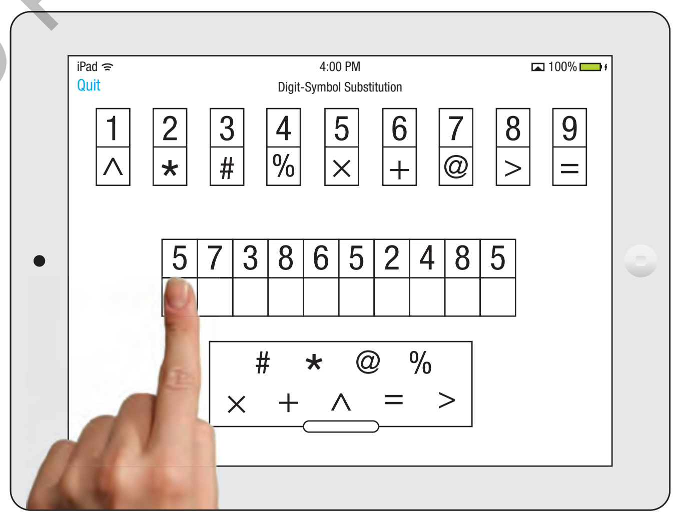


FIGURE 8.23 An example of a computer-delivered cognitive task that usually requires speed and accuracy. Shown is a digit symbol substitution test. Note the digit-symbol pairs top of screen. The test taker must match each number at centre screen with its corresponding symbol as fast as possible. Symbols can be dragged from the panel bottom screen and dropped into place. The number of correct symbols within the allowed time (e.g. 90 or 120 seconds) is usually measured.

eBook*plus*

Poster report on EEG stimulant and depressant research using a speed and accuracy measure

Subjective reporting of consciousness — sleep diaries

Subjective reporting involves the use of self-reports. A *self-report* is the participant's written or spoken responses to questions, statements or instructions presented by the researcher.

Self-reports are considered to be subjective because the data collected from a participant is based on their personal opinion, interpretation, point of view or judgment. Unlike data obtained through objective measures, subjective data is often biased, can vary from person to person, day to day from the same person, and is not always entirely accurate. However, this does not mean that subjective reporting is not useful or cannot provide valuable information about consciousness. Often, asking someone to report one or more aspects of their experience during normal waking consciousness or an altered state is the most appropriate and best way of obtaining information of research interest.

Subjective reporting via self-reports is commonly used in the study of sleep. The sleep diary, sometimes called a sleep log, is the most commonly used method. A **sleep diary** is a self-reported record of an individual's sleep and waking time activities, usually over a period of several weeks. When the activities are to be recorded for children, a parent may maintain the required records.

Sleep diaries are most commonly used in conjunction with physiological measures such as EEG and EMG to support the assessment of sleep disturbances or disorders, particularly their nature, severity and possible causes. The data an individual is required to record in a sleep diary depends on what is being studied. Records may be kept of:

- the time when trying to fall asleep
- the time when it is believed sleep onset occurred
- the number, the time and length of awakenings during sleep
- the time of waking up in the morning
- the time of getting up after waking up in the morning
- how well rested the individual feels upon awakening
- how sleepy the individual feels at different times during the day.

In addition, records may be kept of events that can affect sleep, such as naps, the number of caffeinated or alcoholic drinks, use of medication, meals, exercise type, time or length, and other potentially influential activities when awake or asleep. Records may be in paper and pencil format or digital.

The sleep diary records are analysed by the researcher to identify patterns of behaviour of relevance to their topic of research interest. If the researcher is investigating a sleep onset disturbance, they will be interested in behaviours that might be interfering with sleep. For example, participant habits such as vigorously exercising at night, watching television or using social media in bed have all been found to impair sleep onset.

FIGURE 8.24 <Caption to come>

An example of a sleep diary is shown in figure 8.24. The participant (or patient) is given detailed verbal and written instructions on how to record entries and maintain the diary.

Video monitoring

Video monitoring is most commonly used in the study of sleep and sleep disturbances or disorders. Most sleep centres, clinics or laboratories are fitted with one or more video cameras to record externally observable physiological responses throughout the sleep cycle, including behaviours when falling asleep and when waking. Video monitoring may also be conducted in a home environment.

Responses that may be observed include:

- changes in posture or body position
- amount of 'tossing and turning'
- sleep-related breathing problems
- what happens when awakening from a nightmare or night terror
- responses associated with sleepwalking.

These types of responses can be examined together with those of other types of recordings, then linked to different sleep stages, sleep types or the specific aspect of sleep under investigation. Video monitoring is particularly important with participants (or patients) who have a serious sleep disorder.

Video cameras can simultaneously record sounds and use infrared technology so that recordings can be made in conditions of little or no light. Recordings are made in real time, but computer-assisted technologies can be used for later analysis of a scene or even a single frame. For example, software packages can be used for frame-by-frame analysis (motion segmentation), enhancement of blurred images and 3D enhancements.

Sleep diary

Instructions

1 Write the data, day of the week, and type of day: work, school, day off or vacation.
2 Draw a downward arrow (↓) when you lie down to sleep.
3 Draw an upward arrow (↑) when you wake up.
4 Shade in all the boxes that show when you are asleep at night or when you take a nap during the day.
5 Leave boxes unshaded to show when you are awake at night and when you are awake during the day.
6 Write the following letters in the diary when you do any of the following:
C = when you have coffee, cola, tea or an energy drink
M = when you take medicine
A = when you drink alcohol
E = when you exercise
7 Complete this diary in the morning and evening. Do not complete this diary during the night. Write any additional comments on the back.

<keyed>

SAMPLE

Date	6 am	8 am	10 am	12 pm	2 pm	4 pm	6 pm	8 pm	10 pm	12 am	2 am	4 am	6 am
16 August	↑	C		M			A	M	↓				

WEEK 1

Date	6 am	8 am	10 am	12 pm	2 pm	4 pm	6 pm	8 pm	10 pm	12 am	2 am	4 am	6 am

FIGURE 8.25 Example of sleep diary data.

eBook*plus*

National Sleep Foundation Sleep Diary

eBook*plus*

Case study involving use of home video monitoring to study sleepwalking

FIGURE 8.26 <Caption to come>

LEARNING ACTIVITY 8.10

Review questions

1 Distinguish between each of the following with reference to examples relevant to consciousness:
   (a) objective and subjective measures
   (b) physiological and psychological responses.

2 (a) Explain how a measure of speed and accuracy on a cognitive task could be used to identify or describe someone's level of alertness.
   (b) Suggest an example of a study of alertness using speed and accuracy, other than an example given in the text.

3 Explain, with reference to relevant statistics, why individual scores with standard deviation of 2.5 or more are sometimes discarded by researchers using speed and accuracy measures.

4 (a) Give an example of when video monitoring might be useful for a study of an aspect of normal waking consciousness rather than sleep.
   (b) Give an example of how it could be used to collect data on both physiological and psychological responses.

5 (a) What is a sleep diary and what data is commonly recorded?
   (b) Give an example of how it could be used to collect data on both physiological and psychological responses.
   (c) What are two potential limitations of sleep diaries from a researcher's perspective?

CHANGES IN PSYCHOLOGICAL STATE DUE TO LEVELS OF AWARENESS

Most of our life is spent in normal waking consciousness. Although we shift between different states within normal waking consciousness, our awareness is most often at a heightened level. When we are awake, aware and alert, we know the world is real, we have a sense of time and place, our perceptions and thoughts tend to be organised, clear and meaningful, and we can usually maintain a good deal of control over how we think, feel and behave. Our experience of normal waking consciousness provides the standard by which we judge other states as being altered, distorted or unreal in some way.

When describing, analysing or comparing different states, psychologists do not only refer to the level of awareness. Other qualities of the 'awareness' experience to which they may refer include the contents of consciousness, use of a controlled or automatic process when doing something, perceptual and cognitive distortions, changes in emotional awareness, changes in self-control and the experience of real time.

Content limitations

Generally, the *content* (type of information) held in our normal waking consciousness is more restricted, or limited, than the content of consciousness during an altered state. We are able to exercise some control over what we allow into our normal waking consciousness, for instance, through selective attention. Because a significant amount of information that enters our consciousness is within our conscious control during normal waking consciousness, we can block our awareness of information that makes us feel self-conscious, embarrassed, sad, repulsed, afraid, hurt and so on. However, during altered states of consciousness we generally don't have the same control, therefore the content of our consciousness is not as limited.

The content of normal waking consciousness also tends to be more organised and logical than that in an altered state of consciousness. For example, when we are awake and alert, we are generally able to follow logical steps in solving a problem. By comparison, when we are in an altered state of consciousness, such as when we are dreaming, the content of our consciousness (the images and content of our dreams) is often nonsensical, illogical and disorganised.

Controlled and automatic processes

Towards the top end of the consciousness continuum are the states of consciousness experienced during activities demanding a lot of attention or concentration, such as playing a computer game, solving a complex problem during an exam, or abseiling down a steep rock face. According to American psychologists Walter Schneider and Richard Shiffrin (1977), who led research in this area, activities such as these use a controlled process.

A **controlled process** involves conscious, alert awareness and mental effort in which the individual actively focuses their attention on achieving a particular goal. A controlled process is often required when a task is novel (unfamiliar) or difficult. For example, when you first learn to drive a manual car, you require controlled processing. You have to concentrate on controlling the steering wheel while coordinating use of the accelerator and brake, as well as monitoring events outside the vehicle such as traffic, pedestrians, road signs and traffic lights. When you are learning to drive, you require a lot of concentrated attention.

Controlled processing of information tends to be *serial*; that is, you can usually only perform one task requiring controlled processing at a time. It is

FIGURE 8.27 A controlled process, such as abseiling down a steep rock face, requires a high level of attention.

effortful, makes heavy demands on attention and requires a high level of conscious awareness to be dedicated to a task. It also tends to be relatively slow. For example, because it is often required in unfamiliar or new situations, we don't have a reliable way to respond quickly.

As you gain experience, however, driving becomes a more automatic process that does not demand the same level of attention. Generally, experienced drivers have little trouble driving, listening to talkback radio and maintaining a conversation with a passenger all at the same time. This is because driving a vehicle, as well as detecting and interpreting important information about traffic and the environment that is needed to drive safely, occurs more automatically and requires less attention for the well-practiced driver than for inexperienced drivers. Any activity that requires a low level of attention and therefore a low level of conscious awareness usually involves automatic processing.

According to Schneider and Shiffrin (1977), an **automatic process** requires little conscious awareness and mental effort, minimal attention and does not interfere with the performance of other activities. It is used when a task is simple or familiar and tends to be rapid (e.g. an experienced driver can reverse-park more quickly than a learner driver). Unlike controlled processing, automatic processing also tends to be *parallel*. This means that we usually can handle two or more tasks at the same time.

FIGURE 8.28 When we learn a new task, it is often complex at first and we depend on controlled processing. This enables us to selectively focus our attention on each important aspect of the task. When the task becomes familiar we are often able to use automatic processing, enabling us to divide our attention between a range of other activities or thoughts.

Perceptual and cognitive distortions

Compared with normal waking consciousness, the way we experience sensations and perceptions in an ASC is often different. An ASC seems to have one of two effects on the senses — it either makes them more receptive to external stimuli, or dulls them to such an extent that some sensations are not experienced at all. For example, some drug-induced ASCs make perception of sensory experiences more vivid, so that colours seem brighter, tastes and smells stronger, sounds louder or more variable, and touch more sensitive. In some instances, people may even hallucinate, experiencing perceptions of stimuli or events that are not really occurring. They may see visions or hear non-existent voices. Alternatively, during meditation, an individual may be able to focus their concentration to such an extent that their normal pain threshold (tolerance) is so high that regardless of what is done to them, they report experiencing no pain at all.

Perceptions can be so distorted in an ASC that people may lose their sense of identity (who they are). Some people experience the feeling either that they are someone else or that they are 'outside themselves' looking in. The feeling of losing touch with reality accompanies many ASCs.

Cognitive functioning also tends to become impaired during an ASC. Thought processes are often more disorganised during a waking ASC, as well as during the ASC of dreaming when asleep. In an ASC, thinking is often illogical and lacking in sequence, and difficulties may be experienced in decision making and problem-solving. In addition, people often have trouble remembering events that occur during an ASC. For example, after experiencing an alcohol-induced ASC, people are often unable to recall in detail the events that occurred while they were intoxicated. ASCs induced through marijuana use also result in short-term memory impairment and subtle changes in thinking. In addition, when in an ASC, some individuals also have difficulty recalling information from long-term memory. However, retrieval of information from memory is usually restored when the individual returns to normal waking consciousness.

Emotional awareness

A change in our awareness and experience of emotion is also associated with many ASCs. ASCs appear to sometimes put an individual's feelings into a state of turmoil, resulting in uncharacteristic responses. For example, in an alcohol-induced ASC, some people become more emotional and may express their emotions more openly than in normal waking consciousness. In other ASCs, people have reported feeling emotionless. They have no feelings at all for events or situations that in normal waking consciousness would produce a highly emotional reaction in them. ASCs have also been associated with inappropriate emotional reactions, such as laughing at being told of a friend's death or crying when told a joke. Unpredictable emotional responses are also often associated with ASCs. While intoxicated, for example, an individual may burst into tears or become highly aggressive or excitable for no apparent reason.

FIGURE 8.29 When in an ASC, people typically experience alterations in their perception of the world. These sketches were drawn by a person while in a drug-induced ASC.

Self-control

Changes in our ability to maintain self-control are often evident during ASCs. For example, in an alcohol-induced ASC, individuals often have difficulty coordinating and controlling movements, sometimes being unable to walk down a hallway without stumbling into the walls. As described previously, they may also have difficulty maintaining control of their emotions; for example, behaving aggressively or affectionately to people with whom they would normally not behave this way in a state of normal waking consciousness. Additionally, emotional responses may be amplified; for example, stronger or in excess or what would normally occur when not in the ASC.

FIGURE 8.30 This Thai woman is able to control her pain response while in an altered state of consciousness when being pierced for an important festival.

Similarly, when in a hypnotic state, people are more susceptible to suggestion than when in their normal waking state. This can result in their behaving in a less inhibited way. An ASC induced through hypnosis has also been shown to help people gain greater self-control. For example, therapeutic use of hypnosis has helped some people to stop smoking, gambling or overeating and has assisted others to manage chronic pain (Miller & Bowers, 1993).

Time orientation

Estimation of time is frequently distorted in an ASC. Time seems to pass at a different speed than normal. For some individuals in some ASCs, the passing of time may appear to be quicker, while in other ASCs, time appears to pass very slowly. For example, when you are woken from a nap you may be surprised to learn that only an hour has passed since you fell sleep. It may seem as though you have been asleep for much longer. At other times, you can feel as though you have slept for a much shorter time than you actually have.

FIGURE 8.31

LEARNING ACTIVITY 8.11

Review questions

1 Complete the following table to summarise psychological changes associated with levels of alertness.

Psychological changes	Description	Overall effect on the nervous system and body	
		NWC	ASC
content limitations			
controlled and automatic processing			
perceptual and cognitive distortions			
emotional awareness			
self-control			
time orientation			

LEARNING ACTIVITY 8.12

1 Comparing automatic and controlled processes
Complete the following table to compare and contrast automatic and controlled processes.

Feature	Automatic process	Controlled process
Level of conscious awareness required		
Selective or divided attention		
Speed at which the processing is performed		
Task complexity		
Ability to undertake other tasks simultaneously		
Example		

2 (a) Describe a task you have learned that initially involved controlled processing but that you can now perform using automatic processing.
(b) What change in level of attention was required to perform the task during learning compared with after the learning?
(c) How do you know this task now involves automatic processing rather than controlled processing?

3 (a) Describe a task that you are currently learning that involves controlled processing.
(b) How will you know when your performance of this task involves automatic processing?

4 Are controlled and automatic processes likely to involve explicit or implicit memories? Explain your answers.

COMPARING EFFECTS OF ONE NIGHT OF FULL SLEEP DEPRIVATION VS LEGAL BLOOD-ALCOHOL CONCENTRATIONS

In an influential study on how sleep deprivation can change conscious experience and adversely impact on human performance, Australian psychologist Drew Dawson and neurologist Kathryn Reid (1997) identified a significant relationship between fatigue due to a moderate level of sleep deprivation, legal levels of alcohol consumption and impaired performance. They found that performance on a variety of cognitive tasks following 17 hours of full sleep deprivation (which they called 'sustained wakefulness') had decreased to a level that was equivalent to that of a person with a blood-alcohol concentration (BAC) of 0.05% (which is the legal driving limit in Australia and many other countries). Performance following 24 hours of sustained wakefulness was equivalent to that of someone with a BAC of 0.10%.

Dawson and Reid obtained their results using 40 participants in a repeated measures experiment with counterbalancing. In the first condition, the participants were kept awake for 28 hours (from 8.00 am to 12 noon the following day). In the second condition, they were asked to consume 15 grams of alcohol every 30 minutes until their BAC reached 0.10%. An Australian standard drink contains 10 grams of alcohol (12.5 ml of pure alcohol).

In both conditions, participants were assessed on 'cognitive psychomotor performance' at half-hourly intervals. This required completion of a computer-administered test of eye–hand coordination involving an unpredictable tracking task. Eye–hand coordination involves the visual processing of information to guide hand movements. As well as visual–motor integration, the eye–hand task used in the experiment requires concentration (e.g. selective attention), speed, accuracy and decision making. Performance can also be influenced by other participant variables such as mood and motivation.

As shown in figure 8.32, performance on the task decreased significantly in both experimental conditions. Statistical analysis led Dawson and Reid to conclude that the effects of moderate sleep deprivation (i.e. 24 hours) on performance are similar to moderate alcohol intoxication (i.e. 0.05%). Furthermore, the results showed that the performance impairment effects of moderate sleep deprivation are equivalent to or greater than the level of alcohol that is deemed legally unacceptable when driving, working and/or operating dangerous machinery.

In a follow-up study to test his findings, Dawson compared the effects of moderate sleep deprivation and alcohol on a range of other cognitive tasks and concentration tasks in another repeated measures experiment. Twenty-two participants aged 19–26 years were selected from a group of volunteers after screening for any type of sleep or health problem. Cigarette smokers, non-social drinkers (i.e. more than six standard alcoholic drinks per week) and anyone on medication known to interact with alcohol were also excluded.

There were three experimental conditions to which participants were randomly allocated and completed in a sequence:

Condition 1: alcohol intoxication — consume an alcoholic drink at half-hourly intervals until BAC of 0.10% is reached; complete performance tests hourly

Condition 2: placebo — rim of drinking glass pre-dipped in ethanol to give impression it contained alcohol; equal number of participants drink the placebo or alcohol to help ensure participants remain blind to the treatment condition they are participating in

Condition 3: sustained wakefulness — deprived of sleep for one night; complete performance tests hourly

The performance tests completed by participants in each condition were all computer administered. These included:

- *eye–hand coordination* — a tracking task using a joy stick
- *concentration* — button pressing depending on a particular light being illuminated
- *sensory comparison* — identify the correct visual stimulus from among alternatives
- *grammatical reasoning* — decide whether logical statements are true or false.

Each test session lasted for 15 minutes. Speed and accuracy was also measured and participants received no feedback on their performance to avoid knowledge of their scores affecting performance levels.

The results showed that as the level of blood-alcohol concentration or amount of sleep deprivation increased, performance on the tasks tended to decrease. The drink consumed in the placebo condition did not significantly affect performance. Results on some of the tests are shown in figures 8.33–7. Overall, the effects of one full day's sleep deprivation were like the effects of the legal blood-alcohol concentration of 0.05%. Note also the effects of less than one day's sleep deprivation compared with the effects of a BAC of less than 0.05% (Lamond & Dawson, 1999).

These results were generally consistent with those of Dawson's previous research study. Although there are exceptions, similar results have since been obtained by other researchers on a variety of cognitive and concentration tasks. However, generalising the findings to real life settings from computer simulations often involving relatively simple tasks under controlled laboratory conditions requires careful consideration of a wider range of variables that also impact on human performance and can become intertwined with effects of sleep deprivation and alcohol consumption.

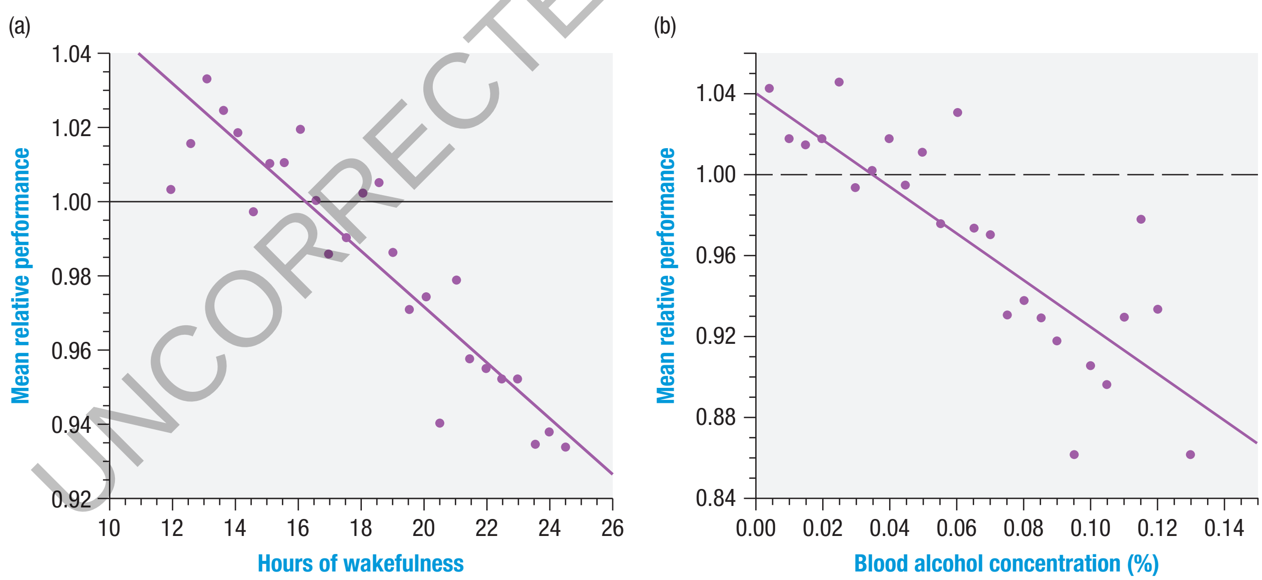


FIGURE 8.32 Scatterplots showing performance in the (a) wakefulness and (b) alcohol conditions in the Dawson and Reid (1997) experiment

Source: Dawson, D., & Reid, K. (1997). Fatigue, alcohol and performance impairment. *Nature*, 388, 235.

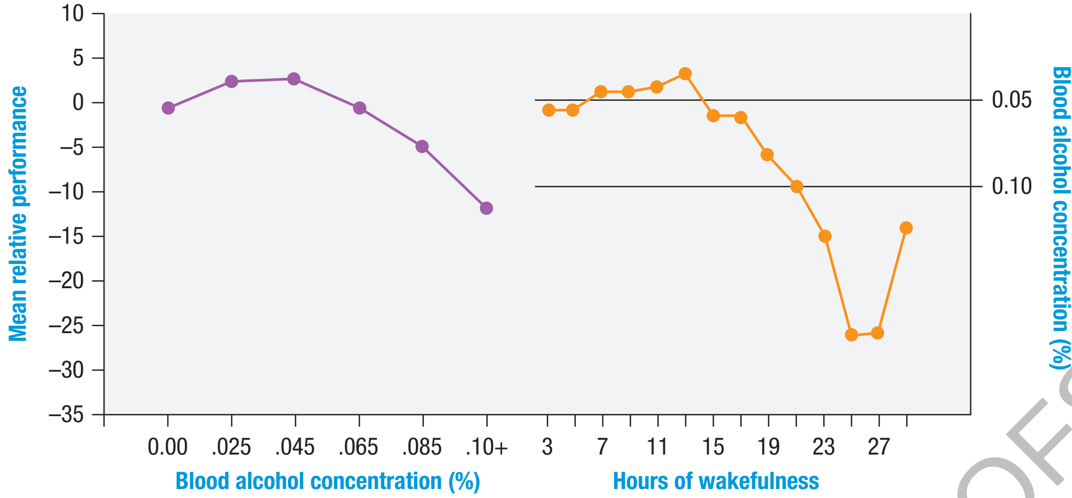


FIGURE 8.33 Mean performance levels for the speed component of the grammatical reasoning task in the alcohol intoxication and sustained wakefulness conditions of the Lamond and Dawson (1999) experiment

Source: Lamond, N., & Dawson, D. (1999). Quantifying the performance impairment associated with fatigue. *Journal of Sleep Research, 8*, 255–262.

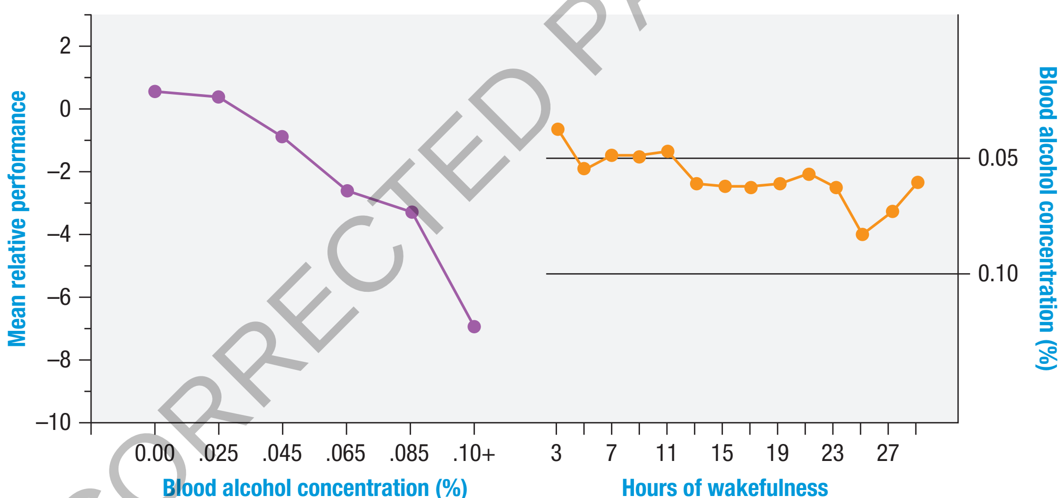


FIGURE 8.34 Mean performance levels for the accuracy component of the grammatical reasoning task in the alcohol intoxication and sustained wakefulness conditions of the Lamond and Dawson (1999) experiment

Source: Lamond, N., & Dawson, D. (1999). Quantifying the performance impairment associated with fatigue. *Journal of Sleep Research, 8*, 255–262.

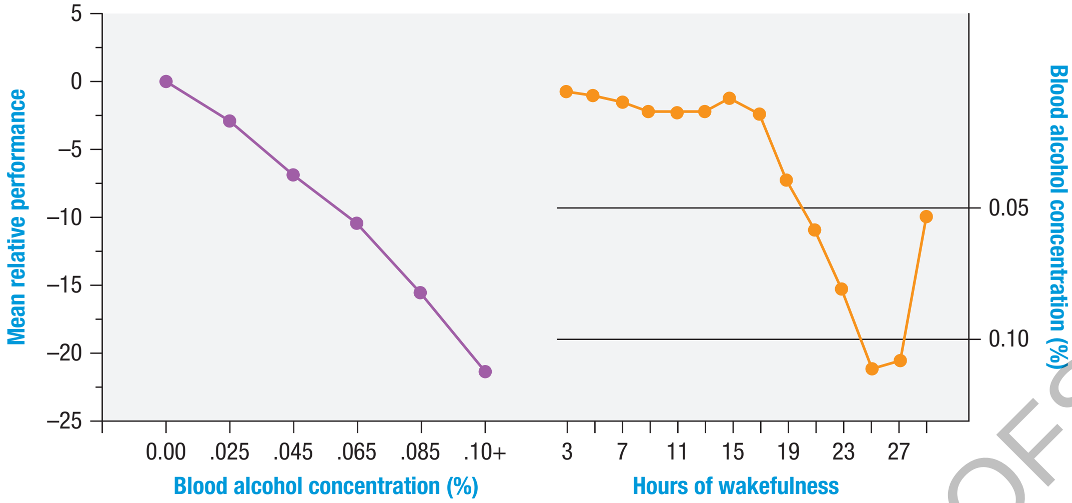


FIGURE 8.35 Mean performance levels for the speed component of the concentration task in the alcohol intoxication and sustained wakefulness conditions of the Lamond and Dawson (1999) experiment

Source: Lamond, N., & Dawson, D. (1999). Quantifying the performance impairment associated with fatigue. *Journal of Sleep Research, 8*, 255–262.

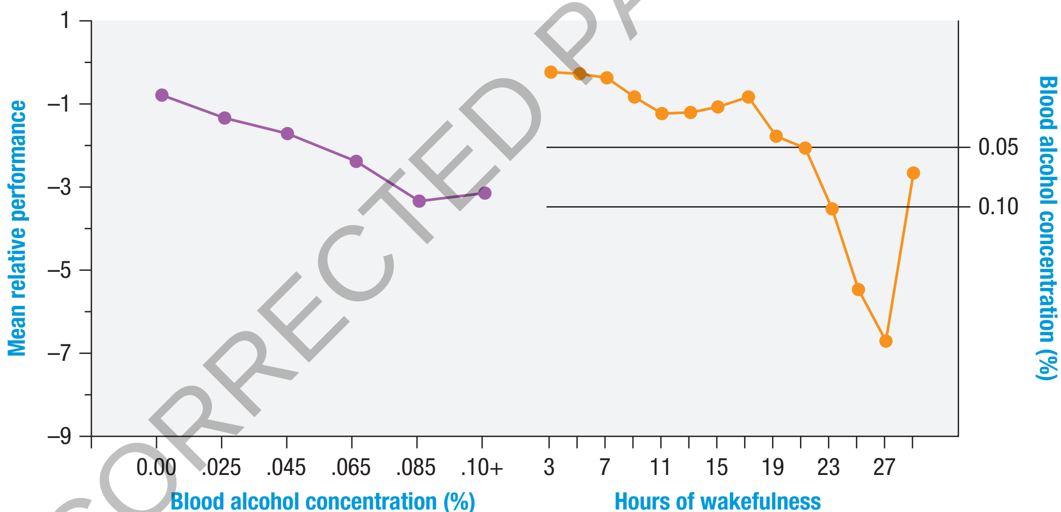


FIGURE 8.36 Mean performance levels for the accuracy component of the concentration task in the alcohol intoxication and sustained wakefulness conditions of the Lamond and Dawson (1999) experiment

Source: Lamond, N., & Dawson, D. (1999). Quantifying the performance impairment associated with fatigue. *Journal of Sleep Research, 8*, 255–262.

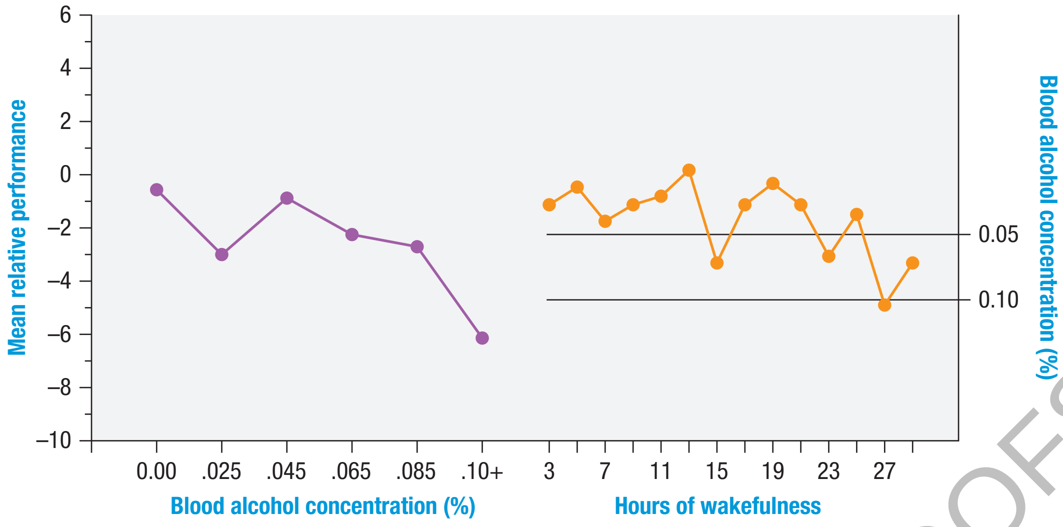


FIGURE 8.37 Mean performance levels for the sensory comparison task in the alcohol intoxication and sustained wakefulness conditions of the Lamond and Dawson (1999) experiment

Source: Lamond, N., & Dawson, D. (1999). Quantifying the performance impairment associated with fatigue. *Journal of Sleep Research, 8*, 255–262.

Mood is one such variable. There is considerable research evidence that sleep deprivation and alcohol consumption, either independently or in combination, influence and are influenced by our mood state. Generally, sleep deprivation results in a negative mood state (e.g. irritability, short-tempered), which you probably know through personal experience, and alcohol consumption results in either a positive or negative mood state, depending on such variables as the amount of sleep deprivation or alcohol, the individual and the context. In turn, our mood state influences our conscious experience and can either enhance or impair concentration and cognitive performance. For example, inadequate sleep can make us cranky and thereby interfere with our ability to concentrate and think clearly. This can undermine performance on a variety of simple and complex cognitive tasks. In addition, our mood can influence alcohol consumption, such as whether or not to drink, what we drink and the rate and amount of consumption. Similarly, our mood can influence sleep deprivation, for example, whether or not we have difficulty falling or staying asleep. In sum, sleep deprivation, alcohol, cognition, concentration and mood are intertwined and may interact in complex ways in influencing conscious experience.

LEARNING ACTIVITY 8.13

Review questions

1 (a) In what way are the effects of a full day's sleep deprivation on cognitive and concentration tasks like the effects of the legal BAC of 0.05%?
(b) Briefly outline a research study that provides evidence of this conclusion and refer to results preceding and up to 0.05% BAC/24 hours wakefulness, as shown in at least two of the graphs on pages 000.

2 How was sleep deprivation operationalised in the Dawson studies?

3 Dawson used a repeated measures experimental design with a counterbalancing procedure in both his studies.
(a) Explain what counterbalancing involves and why it is used.
(b) Describe how counterbalancing was employed in one of the Dawson experiments, ensuring you refer to the relevant experimental conditions.
(c) Explain an advantage and a limitation of the repeated measures design with reference to one of the experiments.

4 (a) What was the purpose of screening volunteers during the participant selection procedure for the second experiment?
(b) Explain whether participant screening biases the sample in such a way as to introduce an extraneous variable.

5 Draw a diagram to show a possible interrelationship between a full day's sleep deprivation, a BAC of 0.05% and mood state.

LEARNING ACTIVITY 8.14

Reflection

The effects of moderate sleep deprivation on concentration have been found to be similar to those of the legally permissible BAC level when driving and in various work settings where safety is a major concern. In light of this, comment on whether there should be a legally permissible level of sleep deprivation. What difficulties might there be in enforcing such legislation?

LEARNING ACTIVITY 8.15

Evaluation of research by Dawson on sleep deprivation, alcohol consumption and performance

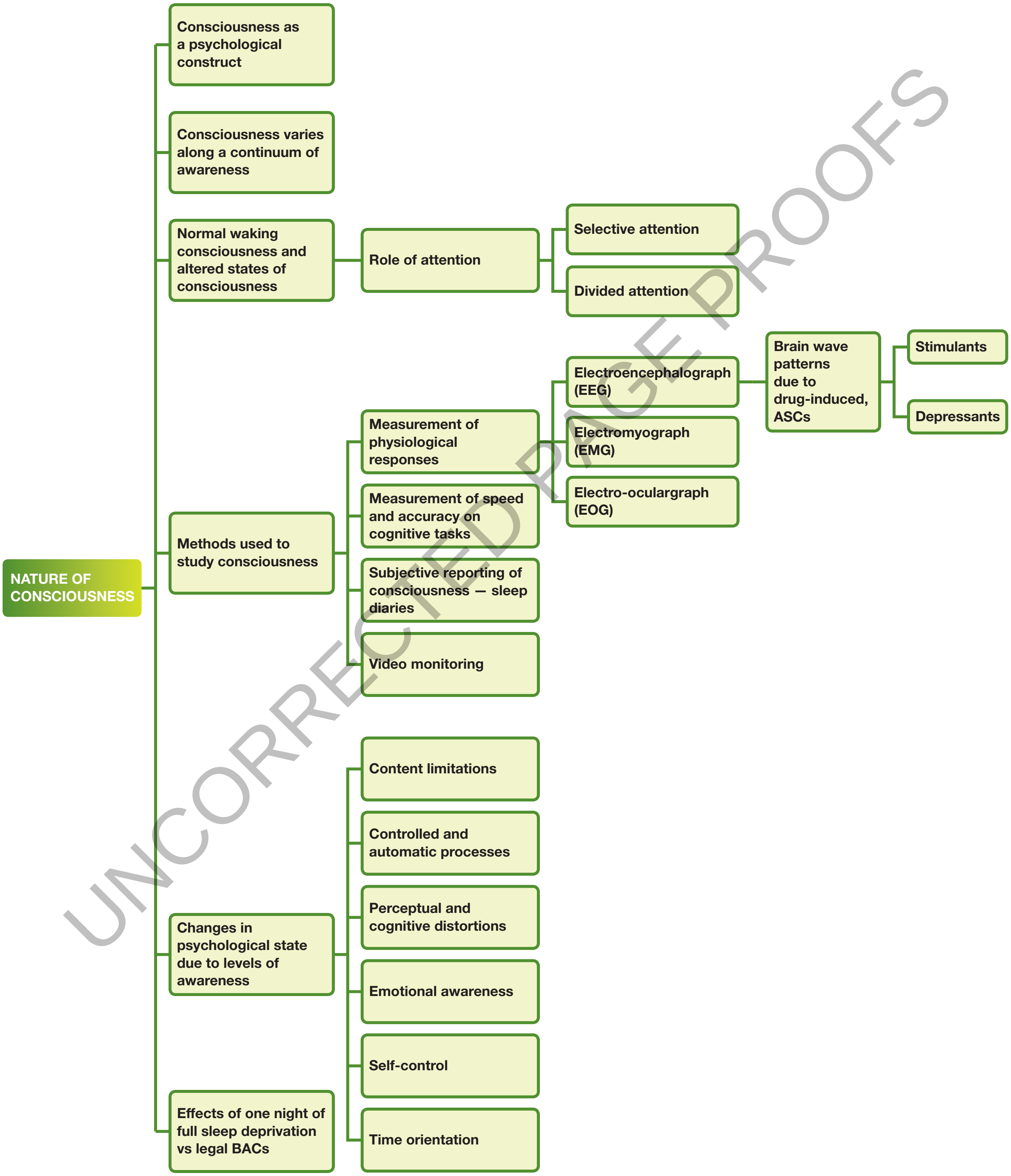
Construct a flow chart to summarise and evaluate one of the experiments conducted by Dawson to compare the effects of sleep deprivation and alcohol consumption on performance of various cognitive and concentration tasks.

Your flow chart should include:

1. a possible research hypothesis for the experiment
2. descriptions of operationalised independent and dependent variables relevant to sleep deprivation, alcohol and at least one of the cognitive or concentration tasks
3. the name of the experimental design
4. participant numbers and selection procedure
5. outline of the experimental conditions
6. statement of results obtained or overall pattern of results in relation to the hypothesis
7. conclusion(s) drawn by the researchers on the basis of the results obtained.
8. a limitation of the research design
9. a comment on the generalisability of the results to real life.

CHAPTER 8 REVIEW

CHAPTER SUMMARY



KEY TERMS

accuracy p. 000
altered state of consciousness (ASC) p. 000
attention p. 000
automatic process p. 000
consciousness p. 000
continuum of awareness p. 000
controlled process p. 000
depressants p. 000
divided attention p. 000
drug p. 000
electro-oculargraph (EOG) p. 000
electroencephalograph (EEG) p. 000
electromyograph (EMG) p. 000
induced p. 000
naturally p. 000
normal waking consciousness p. 000
psychological construct p. 000
selective attention p. 000
sleep diary p. 000
speed p. 000
states of consciousness p. 000
stimulants p. 000

LEARNING CHECKLIST

Complete the self-assessment checklist below, using ticks and crosses to indicate your understanding of this chapter's key knowledge (a) before and (b) after you attempt the chapter test. Use the 'Comments' column to add notes about your understanding.

Key knowledge I need to know about xxx	Self-assessment of key knowledge I understand *before* chapter test	Self-assessment of key knowledge I need to revisit *after* chapter test	Comments

CHAPTER TEST

SECTION A — Multiple-choice questions

Choose the response that is **correct** or that **best answers** the question.
A correct answer scores 1, an incorrect answer scores 0.
Marks will **not** be deducted for incorrect answers.
No marks will be given if more than one answer is completed for any question.

Question 1

When experiencing normal waking consciousness

A. we cannot shift to an alternate state unless we choose to do so.
B. we are usually aware of our internal state but not the external world.
C. we can usually restrict the type or amount of content flowing in and out.
D. we are usually aware of our internal state but not the external world.

Question 2

James can sing along to music on the radio while driving his car and efficiently navigate to his friend's house at the same time. This illustrates a feature of consciousness involving

A. concentration.
B. selective attention.
C. divided attention.
D. controlled processing.

Question 3

Which of the following procedures is best for collection of self-report data to study consciousness?

A. video monitoring
B. sleep diary
C. laboratory observation
D. naturalistic observation

Question 4

A computer-assisted speed and accuracy test is best described as a/an _____ measure.

A. subjective
B. objective
C. biased
D. physiological

Question 5

Brianna is relaxing with eyes closed after having concentrated for more than 15 minutes while solving a complex maths problem. When solving the problem, Brianna's brain wave pattern was predominantly _____ waves , and when she relaxed and closed her eyes it was predominantly _____ waves.

A. alpha, beta
B. beta; alpha
C. theta, alpha
D. beta; delta

Question 6

High-frequency brain waves are ____ and therefore involve ____ brain waves per unit of time.

A. faster; more
B. slower; less
C. faster; less
D. slower; more

Question 7

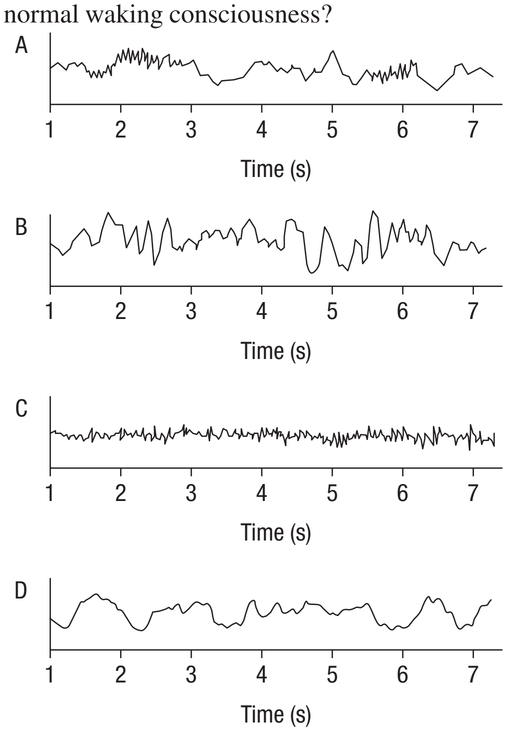
Ollie has a very high fever after contracting a virus. While lying awake in bed, he begins to feel as though ants are crawling all over his body, and says he can see them, despite there being no ants.

Ollie is most likely experiencing ____ with ____ .

A. normal waking consciousness; self-control
B. normal waking consciousness; divided attention
C. an altered state of consciousness; perceptual distortions
D. normal waking consciousness; perceptual distortions

Question 8

Which pattern shows the brain waves of a very alert person during normal waking consciousness?



Question 9

A basketball player is given a penalty shot at the goal from the free-throw line. The brain wave pattern associated with this activity is most likely to have ____ frequency and a ____ amplitude.

A. high; high
B. low; high
C. low; low
D. high; low

Question 10

Which of the following is the more likely to be associated with an altered state of consciousness rather than normal waking consciousness?

A. misperception of the passage of time
B. self-control
C. emotional control
D. heightened self-awareness

SECTION B — Short-answer questions

Answer **all** questions in the spaces provided. Write using blue or black pen.

Question 1 (2 marks)

An ____ is used to collect data on muscle tone and activity, whereas an ____________ ____________________________ is used to collect data on eye movements and position.

Question 2 (1 mark)

As the level of alertness increases and attention intensifies when awake, __________________ brain waves become more rapid.

Question 3 (1 mark)

You want to observe theta waves as they actually occur in an adult during normal waking consciousness. What mental and/or physical activity should the person perform to increase the likelihood of theta wave activity?

Question 4 (2 marks)

Explain why consciousness is considered to be a psychological construct.

Question 5 (2 marks)

Explain why daydreaming is considered to be an altered state of consciousness.

Question 6 (4 marks)

(a) State two variables that can directly influence the specific effects of a depressant or stimulant drug on consciousness. 2 marks

(b) Describe the brain wave pattern most likely to be induced by:

(i) depressants 1 mark

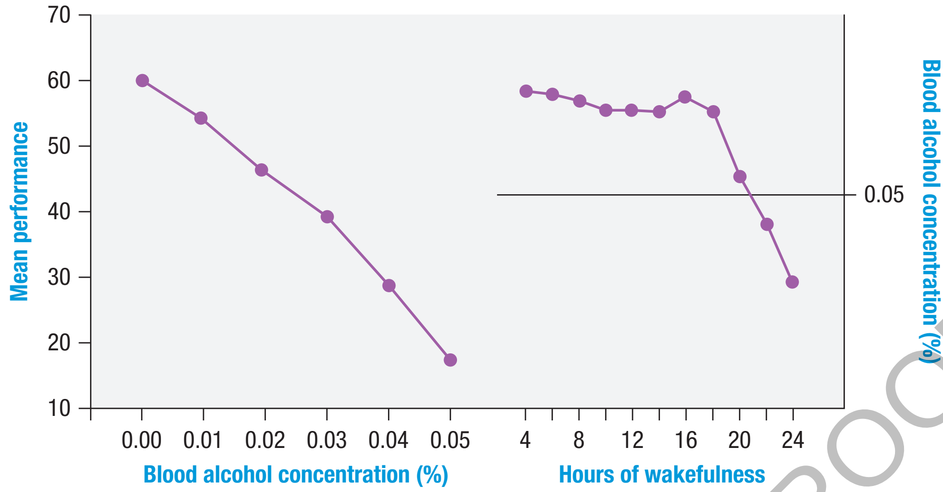
(ii) stimulants 1 mark

Question 7 (4 marks)

Distinguish between controlled and automatic processes with reference to the activity of the juggler shown below.

Question 8 (3 marks)

Describe the effects on consciousness of one full night of sleep deprivation compared with the effects of legal blood-alcohol concentrations. Refer to the graph below showing results on a cognitive task requiring concentration.



Question 9 (11 marks)

An experiment was conducted to investigate the effects of consuming chocolate on brain wave activity. One hundred and twenty-two participants were randomly assigned to one of three conditions and consumed either chocolate with a high (60%) concentration of cacao (the active ingredient in chocolate), low (0%) cacao chocolate, or water. Brain waves and mood were measured before and after a 60-minute digestion period. The results showed a decrease in theta and alpha activity and an increase in beta activity in the frontal and parietal lobes following consumption of a 60% cacao chocolate bar compared with control conditions. No condition-specific mood changes or sex differences were found.

(a) Name the device used to measure brain wave activity. 1 mark

(b) Name the experimental design. 1 mark

(c) Identify the experimental and control groups. 1 mark

(d) Explain why random assignment was used. 1 mark

(e) What was the placebo treatment and why was this used? 2 marks

(f) Explain whether chocolate is a stimulant or depressant drug on the basis of the results obtained. 3 marks

(g) Give an example of a cognitive task the researcher may have used to assess levels of alertness after the digestion period and explain why this would be a suitable task. 2 marks

Return to the checklist on page XXX and complete your self-assessment of areas of key knowledge where you need to do more work to improve your understanding.

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The answers to the multiple-choice questions are in the answer section at the end of this book and in eBookPLUS.

The answers to the short-answer questions are in eBookPLUS.

Note that you can also complete Section A of the chapter test online through eBookPLUS and get automatic feedback. **int-0000**